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J. M. WAKEMAN, - - - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - Associate Editor.

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THE NATIONAL ELECTRIC LIGHT CONVENTION.

The electric light convention at Cincinnati last week, to which we devoted a 16-page supplement last week, far exceeded any previous gathering of the kind, both in the number of interested attendants at all sessions and in the volume and value of the proceedings. That the attendance at the sessions kept up in spite of the depressingly hot weather, which the stifling atmosphere of the convention hall did not render any more bearable, and that almost the entire time for three days, including evenings, was taken up by sessions, demonstrated the fact that something more than ordinary was presented by the management. The unusual success of the recent gathering was, undoubtedly, due to the energy, enthusiasm and untiring work of ex-President Doherty. His administration has marked a turning point in the affairs of the association, and, in view of the new life which he has instilled into it, it is a matter of regret that precedent did not allow his continuance in office for an additional term or two. The only criticism that could be made on the programme which he served up to the association, was as to its superabundance. So many subjects were taken up at length, by discussion prepared in advance, by the "question box," and by discussions on the floor of the convention, that members at times became satiated with the amount of good things laid before them, and were unable to appreciate and discuss many matters as clearly as might have been had fewer subjects been taken up. The success of the convention was a full indorsement of President Doherty's plan of making a programme which differed considerably from the programmes of former years, in that each subject was discussed by several members in advance. Although some of these discussions lengthened into what might be termed "Papers," as a rule, better results were secured than by the old plan of a single paper on a subject and with impromptu discussion. The mass of discussions printed in advance and presented to the convention was so great that it is doubtful if any of the members present will have read and digested them all fully even by the time this issue reaches its readers, and the additional proceedings of the convention taken by the official stenographer would make another volume equally as large. As to the large attendance, it may be noted that the action of the association in reducing membership fees to minor central stations operating in the smaller cities, of course, has as its aim the attraction of small companies, and is along the commendable line of policy advocated and followed by President Doherty.

In the selection of Mr. L. A. Ferguson as president, and Lieut. Cahoon as secretary, the convention has probably made the wisest move possible to have continued the energetic policy started by Mr. Doherty. The selection of Chicago for the next convention came as somewhat of a surprise to Eastern members, who naturally expected New York to be selected for 1903, after the association had accepted the invitation of the Louisiana Purchase Exposition to meet at St. Louis at the Exposition in 1904. However, it must be remembered that ours is a big country, and those who urged the selection of Chicago as the next meeting place may be right in their position that it would be a mistake at the present time, when the membership of the numerous smaller central stations in the middle west is being solicited, to compel a trip to the Atlantic seaboard for all who wish to attend the convention. Although the Atlantic states still have the preponderance in the number of supply men and manufacturers, the central stations are distributed over the country very nearly according to population, the present center of which is in

Indiana, and even with a Chicago convention, central station men from the far west have much more to complain of in the way of a long trip than do those from the Atlantic states. At the same time, we have a lingering conviction that at this season of the year Western managers have no great objection to getting nearer to the sea.

The 3500-volt Limit for City Over-head Lines.

As many of our readers know, a proposed amendment to the Underwriter's National Code provides that no overhead electric circuit carrying wires having a difference of potential of more than 3,500 volts alternating current between them should be allowed within 75 feet of any building. This rule has been under consideration by a committee of the American Institute of Electrical Engineers for some time, and it is perhaps well that attention was also called to the proposed rule at the recent convention of the National Electric Light Association, as a body of practical men of this kind are able to deal with an obstructive rule of this character with effect. There are already installed in our large cities miles upon miles of circuit which, under this rule, would either have to come down or the insurance could be canceled in any of the buildings along the street. As Mr. W. L. Abbott, of Chicago, pointed out, since these circuits cross other circuits of various kinds, the existence of such circuits in a city should logically cause the canceling of the insurance on an entire city if such a rule went into effect. Captain Brophy suggested that there is no consistency in restricting the voltage on alternating-current circuits to 3,500 volts and allowing 8,000-volt, direct-current arc circuits to go unmolested. The use of higher voltages than 3,500 for transmission distribution in cities is becoming so common, and the rules which should govern the construction of high voltage circuits of this kind are becoming so well known, that the resolution unanimously passed by the National Electric Light Association, saying the proposed rule is uncalled for, and that good construction of such circuits rather than their prohibition should be the remedy for any troubles from them, is most timely.

High versus Low Economy Lamps.

For a number of years the tendency among central stations has been towards the use of incandescent lamps of higher and higher economy. It has, of course, been to the advantage of lamp manufacturers to encourage this tendency, and it has furthermore been advocated as the most economical form of practice by a large number of progressive central station managers. Discussion on the subject has been on the wane for several years, but was revived at the National Electric Light Convention last week with the vigor of a normally slumbering West Indian volcano. The most ardent champion of the low economy lamp, with an energy consumption of about 4 watts per candle, as against one of about 3.1 watts per candle, was President Doherty, while among the central station men, President-elect Ferguson, of Chicago, took a most decided stand in favor of the 3.1-watt lamp. When two such doctors disagree, there is certainly good reason for analyzing the subject thoroughly before arriving at a conclusion. Stated in as simple terms as possible, the argument of the advocate of the low-efficiency lamp is this: If a central station having 3.1-watt lamps should replace these lamps with those taking 4 watts per candle, there will then be required about 13 per cent. more energy to furnish the customer with the same amount of light as formerly. It is proposed to reduce the rate per kilowatt-hour charged a customer by 13 per cent., so as to give him the same rate per thousond candle-power hours as with the high-economy lamp. Now, it is claimed by the low-economy advocate that the saving in lamp renewals by this process will not only compensate for the increased amount of current which must be supplied for a given price, but will leave a balance in favor of the central station; at the same time giving the consumer the same amount of light as before for the same money. Whether this is true or not manifestly depends on two things: The difference in cost of lamp renewals per kilowatt-hour between the high and low-economy lamps, and the actual cost to the central station of the 13 per cent. additional energy which must be supplied as a result of the change to the 4-watt lamps. The cost per kilowatt-hour for lamp renewals of 16-c.p. lamps was given in the discussion by Mr. F. W. Willcox as .73 cent for the 3.1-watt lamp and .18 cent for the 4-watt lamp. For the sake of argument, assuming these figures to be correct, it is evident that the central station must be able to supply the 13 per cent. additional energy to the consumer at a very low cost, and the whole discussion hinges on the actual cost of this additional current.

The partisans of the low-economy lamp claim that in the stations for which they advocate the use of such lamps, the only increased cost is that due to the additional amount of fuel which would be burned in order to produce that much extra current. If a station was not fully loaded so that no additional investment would be required, this contention might hold true so long as no additional capacity in generating machinery or distributing system had to be installed; but such a condition could only exist for a short time, and if interest, depreciation and distribution costs be figured in, there is surely no profit in the change to lower economy lamps. Indeed, it might be argued on the other hand that if, instead of decreasing the lamp efficiency by 13 per cent. additional, consumers could be taken on to that amount, it would increase the gross revenue 13 per cent. To us it appears evident as a general proposition that in a live central station with a growing load the higher economy lamp is the more desirable. But there may possibly be special cases in which the lower economy lamp will be more economical, and the recent discussion at the convention was of benefit in that it will set central station managers to thinking and considering each case on its merits, rather than following a general rule, however few its exceptions.

The 220-volt Lamp.

One of the noteworthy papers at the electric light convention was Mr. Bailey's report on tests of 220-volt incandescent lamps. These high-voltage incandescents seem to be steadily coming into more and more extended use, whatever their ultimate status may prove to be. They certainly have their uses, and must be reckoned with as a factor of some importance in the art. Mr. Bailey's tests were on a considerable scale, embracing 14 lots of 50 lamps each, purchased in the open market, and including practically all the makes of 220-volt lamp available in this country. All were of 16 candle-power, although the author notes that one of the weak points of 220-volt service is the lack of good 8-cp lamps. In our observation, there is rather a strong tendency toward the use of 20 to 32-cp lamps at 220 volts, and we wish that some of these had been included in the tests. The general result was such as might properly have been expected, and was by no means cheering. The most conspicuous failing was complete lack of uniformity in rating. The target diagrams are something horrible to see, and only two or three of them would be considered tolerable by the station manager. These two or three, however, were pretty good, and show that some makers at least are careful and conscientious in sorting the product. Most of the lamps were rated at about 4 watts per candle-power, and one lot thus rated actually showed 5.6 watts per candle. Only one lot was rated below 3.5 watts per candle-power, and it is interesting to note that this was conspicuously good in most respects, showing an initial average of 3.29 watts per candle, and an average of 6,545 candle-power for the useful life prior to falling below 80 per cent. of the initial intensity. The tests show very plainly that while it is possible to make a good 16-cp, 220-volt lamp, and while such lamps can be obtained in the open market, they are the exception, and few makers are careful

enough in sorting and rating the product. The obvious moral is to test this class of lamps with exceptional care and to insist on getting the best. These, as Mr. Bailey's tests show, are very creditable, although painfully rare.

THE DEMAND SYSTEM IN CHICAGO.

A most timely paper at the recent electric light convention was Mr. Ferguson's very interesting account of the experiments in the use of the demand system in Chicago. There is certainly a general call for some improvement over the flat-rate system in any of its usual modifications, and the results of experience on so large a scale as at Chicago cannot fail to be instructive. It is practically agreed on all sides that there is need in every large station for something better than any fixed arrangement of discounts based on gross quantity alone. There is no simple, or perhaps no practicable, way of taking into account all the variables which enter into the cost of furnishing energy to a given customer. Even if there were, it is a grave question whether it would be the best policy to apply it, or whether when applied it would not prove a nuisance and be put down by legislative enactment. The demand system, which practically bases discounts on the customer's load factor, has at least the merit of relative simplicity and of dealing somewhat directly with one important feature of cost of supply. Mr. Ferguson found, as others have done, that the original scheme required some modification to fit it to local conditions, and based upon it a somewhat empirical schedule which appears to have worked admirably. On two points we could have wished for additional information. Why is the demand system applied almost entirely to small consumers, and what has been the actual effect upon their monthly bills and upon the rate per kw-hour actually paid? We think there is room for much valuable study of this matter of rates, but a searching investigation of the "preparation" item would often be decidely awkward and difficult; and the Chicago plan, albeit empirical, appears to have much more to recommend it to the ordinary manager. Truth to tell, any reasonably simple system of charging must be somewhat empirical, and the vital point is to evolve a system easy to operate and for the customer to understand, and nearly as may be fair to all classes of consumers, and of a character not likely to stimulate unprofitable business.

THE PROTECTION OF LONG DISTANCE TRANSMISSION LINES.

A collection of five short papers on this subject was read before the National Electric Light Association at Cincinnati, abstracts of which appeared in our issue of last week. The papers all relate to plants in the belt of territory comprised between the 45th and 50th degrees of north latitude, but from as far west as Snoqualmie and as far east as Quebec. The troubles which are experienced in these various plants are reported as differing considerably. At Seattle there are very few thunder-storms, and the difficulties on the transmission lines arise from big timber and rifles. At St. Paul lightning gives serious inconvenience. From Colorado and Niagara there are reports of minor troubles from lightning. At Quebec, although there is a good annual share of thunder-storms, yet the high-pressure lines, operated at 23 kilovolts, have not suffered appreciably from lightning, although some lightning troubles have occurred on the low-pressure side of the system. There can be little doubt but that as time goes on the transmission line will come to be regarded as the weak point of electric power systems. Generators, motors, and apparatus are all undergoing evolution and improvement, but the lines must always remain liable to injury by storms, falling trees, neighboring fires and malicious damage.

The records of break-downs due to malicious interference with transmission lines are already numerous, especially in the West, where the white porcelain insulators make attractive targets for the rifle. Insulators of brown porcelain are in some cases preferred to those of white porcelain, as being less conspicuous and alluring to the sportive instinct. Still more troublesome are the short-circuits maliciously produced by pieces of wire thrown across the line wires. For malicious short-circuiting exemplary imprisonment is the best protection, although detection and conviction are very difficult. Some protection has been occasionally gained by the judicious dissemination of information in the public press as to the dangers to which the employés in the power-houses are exposed by wanton short circuits. As regards lightning, the discussion makes it evident that there is room for considerable improvement in arresters; but after everything has been done to improve arresters, there must still be cases in which lightning discharges will occur beyond the power of any arrester to control or avert. Perhaps the most complete immunity from lightning discharges on the lines can be obtained by installing an iron grounded wire above the transmission wires, as has often been tried with more or less success; but this plan, besides its expense, has the advantage of adding one more wire necessary to maintain and keep from crossing. When, however, much synchronous machinery has to be operated, the sensitiveness of this machinery to atmospheric electric disturbances may eventually make necessary some overhead ground shielding of the transmission lines.

THE VELOCITY OF LIGHT.

The current *Bulletin* of the American Physical Society contains an abstract of an important paper by Michelson on this subject, which is his specialty, and to which he has so largely contributed. The mean distance of the sun from the earth, or the mean semidiameter of the earth's annual orbit, is a very important astronomical constant, as it forms the base line for estimating the distances of stars. Its accurate measurement has been the quest of astronomers for centuries, under the title of "the mean solar equatorial parallax," or the mean angle subtended by the earth's radius to a hypothetical observer at the sun's center. This angle is something like 8¾ seconds of arc (usually taken as 8.78) with a probable error of 1/175, obtained from purely astronomical observations. Michelson shows that by purely optical methods the observed velocity of light and the observed siderial aberration constant give a solar parallax of 8.808", with a probable error of less than 1/1000th. He regards the optical method of measuring the sun's distance as inherently more trustworthy, and far less expensive, than the astronomical methods.

The highest development of the optical method calls, then, for as accurate a knowledge of the velocity of light as can be experimentally observed, and in this direction we have the aid of three converging sets of experimental methods; namely, those of electromagnetic measurements of the light-speed ratio v; those of invisible Hertzian waves; and those of visible light waves. He quotes the report of the 1900 International Physical Congress as giving 300,010 kilometres per second for the best result with v; 299,130 kilometres per second for Hertzian-wave measurements, and he inclines to 299,890 ± 60 kilometres for the best result with optical measurements. Finally, a new method of optical measurement is outlined, a sort of combination of the methods of Foucault and Fizeau, for measuring with a revolving mirror, making 250 turns per second, the retardation in light during a journey of six meters, magnified by a luminous pointer virtually 6 kilometres long, and using a stationary grating reflecting surface acting as a toothed-wheel. With this experimental method it is hoped that the speed of light may be measured to within 5 kilometres per second or less. It seems curious to reflect that the most accurate way of measuring the distance of about 150 million kilometres to the sun is by carefully measuring a distance of three metres, and the time it takes light to travel to and fro across this little space.

Engine Builders' Convention at Pittsburg, Pa.

The Engine Builders' Association of the United States held a semi-annual meeting at the Schenley Hotel, Pittsburg, Pa., on May 22 and 23. Among those in attendance were: H. L. Ide, president A. L. Ide & Sons, Springfield, Ill.; W. R. Fleming, president Harrisburg Foundry & Machine Works; D. N. McBrier, vice-president Ball Engine Company, Erie, Pa.; F. A. Millard, president Murray Iron Works, Burlington, Ia.; Walter C. Kerr, Westinghouse, Church, Kerr & Co., Pittsburg, Pa.; George E. Gaskell, manager at Philadelphia for Ames Iron Works, Oswego; Thos. C. Wood, Ball & Wood Co., New York; C. A. Gates, secretary Russell Engine Co., Massillon, Ohio; Wm. Taylor, president Chandler & Taylor Co., Indianapolis; H. A. Chuse, superintendent Chuse Engine Works, Mattoon, Ill.; Prof. John E. Sweet, president Straight Line Engine Works, Syracuse, N. Y.; J. H. McGregor, Goldie & McCulloch Co., Ltd., Galt, Ont.; A. K. Spotton, Goldie & McCulloch; C. B. Little, The Brownell & Co., Dayton, Ohio; C. H. Sembower, Orr & Sembower, Reading, Pa.; S. H. Payne, Payne Engine Co., Elmira, N. Y.; F. M. Rites, Ithaca, N. Y.; E. H. Sniffen, Westinghouse, Church, Kerr & Co., New York; S. F. Bogg, Watertown Engine Co., Watertown, N. Y.; W. M. Howell, Phœnix Iron Works, Meadville, Pa.; E. L. Clark, Westinghouse, Church, Kerr & Co.; S. B. Richards and Edwin Baillie, Buckeye Engine Co.; Fitz John Porter, Bethlehem Steel Co.; H. M. Longwell, Westinghouse Machine Co.; J. M. Wakeman and T. C. Martin, ELECTRICAL WORLD AND ENGINEER; C. W. Rice, Nernst Lamp Co., Pittsburg; P. D. Wagoner, General Electric Co.; George Bullock and R. T. Lozier, Bullock Elec. Mfg. Co.; W. G. Bole, Westinghouse Machine Works.

A brief address of welcome was delivered on Thursday at the opening by President Taylor. A paper on "Engine Forgings" was read by Mr. H. F. J. Porter, of the Bethlehem Steel Co. Papers were also read by Mr. E. M. Tingley, of Pittsburg, on "Engine Requirements for the Parallel Operation of Alternators;" by Mr. H. M. Longwell, of Pittsburg, on "The Requirements for the Paralleling of Alternators as Viewed by the Engine Builders"; and by Mr. John B. Berryman on "Piping Material for Steam Plants." The paper by Mr. Longwell appears in abstract elsewhere in this issue.

The paper by Mr. Tingley noted that the Westinghouse Electric Manufacturing Company had been called upon for information and suggestions as to the parallel operation of engine-type or direct-connected alternators, and that their work in this direction had crystallized into the form of specification. He then gave the details and discussed the various sectional paragraphs. He remarked that the parallel operation of alternators driven by water-wheels had been uniformly successful, and that the same should be true of engine-driven machines. With suitable governors, and allowing ample fly-wheel capacity, there was no reason to doubt that in all cases successful parallel running could be duly accomplished.

The paper by Mr. Berryman on piping material for steam plants was an admirable discussion of this topic as viewed from the standpoint of the practice of the Crane Company, of Chicago, and described a series of results obtained in testing in the field of high pressures. The paper took up the various details of pipe, flanged joints, facing flanges, cast-iron flanges, flanged fittings, valves, and pipe bends. Summing up his paper, Mr. Berryman made a strong recommendation of the use of standard, staple, catalogued articles. He could see no use for the enormous variety of special goods they and others were called upon to produce, many of which embodied only some fad or whim of the engineer in charge of an installation. Besides, with standard goods, there is reasonably prompt shipment and lower price.

Friday morning was devoted to an executive session, and then, after lunch, the delegates, accompanied by friends, visited the shops of the Westinghouse Machine Company at East Pittsburg. This large plant is even now in process of extension, a new erecting shop being rapidly erected. The party were escorted around by Messrs. Keller and Bowles, of the executive staff, and saw everything, including gas engines, steam turbines, small "Kodaks" and the enormous engines for the latest generating plants in New York City. A visit was then paid to the adjoining works of the Westinghouse Electric & Manufacturing Co., where generators to be attached to these engines and motors to be energized by their current were seen in every stage of production.

In the evening a banquet was given at the Schenley, which was well attended, but which broke up at the early hour of 9:30, on account of the fact that many present had to catch night trains. Mr. Taylor presided and Mr. Gates acted as toastmaster. Among those who were called upon to speak were Messrs. Wood, Wakeman, Spotton, Longwell. Mr. Martin, who was called upon to speak for the electrical interests in relation to engine building, deprecated strongly the suggestion in Mr. Longwell's striking paper that the modern electrician was a man of marvel and mystery. That might have been true in earlier days, when the electrical inventor with a "system" of his own could be described in the couplet applied by Cowper to a distinguished master of legerdemain of his day: "Like Katerfelto, with his hair on end, at his own wonders wondering for his bread." Such times had passed, and with them had gone the electrical "wizards," "magicians" and charlatans. Nothing had contributed more to this than the fact that electricians had been able to hitch up to steam. Out of a total production of nearly $110,000,000 of electrical apparatus in the United States in 1900, at least $75,000,000 was due to the use of current generated from dynamos, and all of which would have been impossible with other sources of power. Looking back to the days which he could well remember, when Prof. Sweet coupled his earlier engines to the first Brush arc dynamos, and when Edison was glad to summon the Armington & Sims engines to his aid, it could be seen that improvements in engines and dynamos had gone hand in hand. That process would continue, he believed, and even such magnificent machinery as they had seen that day at the Westinghouse works was not the end. He could promise the engine builders that whatever other opportunities they had, electricity would help them to build bigger and bettter in the days to come than they had ever done before.

Mr. B. J. Arnold to Report on Chicago Traction Problems.

Mr. B. J. Arnold has been selected as engineering expert by the Chicago City Council in an investigation to be made of the Chicago traction problem. Mr. Arnold's duties will be multifarious, as will be seen from the following synopsis of the work to be done:

He will prepare an estimate of the cost of a new and adequate urban system designed along the lines of the best practice in vogue, and an estimate of the net earnings of such system, based on present business. He will report on the feasibility and desirability of an underground conduit system in the downtown district and on all trunk lines within prescribed limits, with arrangements for transferring from overhead to underground trolley, and suggest new routes for the present lines outside the business district, in order to furnish the best facilities to residents. He will furnish preliminary plans for a system of subways in the business district, which, coupled with the surface system of terminal facilities, will supply adequate accommodations to the public, and also provide for an increase in traffic in years to come, relieve the congested district, and create a much larger district available for business purposes. Among other things which will be required of Mr. Arnold are the following:

Report on the necessity for the abandonment of the practice of operating cars in trains. Report on a universal system of transfers. Make an estimate of the value of all lines whose franchises do not expire in 1903. Report on the desirability of through routes as against down-town terminals; on the advisability of joint use of tracks by the companies, and on the possibility and cost of converting cable lines into underground trolley lines; rearrangement of the Union Loop; a plan for the prevention of electrolysis, and an estimate of the cost and the advisability of laying cement roadbeds.

Among other work will be a report on the cost of operation and the earnings of the present street railway companies, on their capitalization, and a valuation of the present plants; an estimate of the number of passengers carried during different hours of the day, and a report on the wages paid employees, and the rules and regulations under which they work, together with recommendations for changes. Mr. Arnold will also be required to submit a standard rail design for use in the future.

Without affiliations with any of the manufacturing companies, and possessed of a rare judgment, not only with respect to technical details but also the broader questions involved in large engineering operations, the Chicago Council is to be congratulated upon the choice of Mr. Arnold as its engineering expert. Moreover, as an engineer in independent practice and high professional character, who can always be counted upon to consider every question in a spirit of fairness to all of the interests concerner, Mr. Arnold's appointment is doubtless entirely satisfactory to the traction companies.

A Model Suburban Electric Station.

REVERE and Winthrop, suburban towns along the shore of Boston Bay, lie within limits of more than three, but less than seven, miles from the State House on Beacon Hill. The population at the census of 1900 was 10,395 in Revere and 6,058 in Winthrop.

The former of these towns furnishes the site, and both of them the distribution area of a model station for electric lighting. This property is owned by the Suburban Gas and Electric Company, which supplies both gas and electrical energy in the towns named. Gas is not manufactured by this company, which acts simply as a distributor of gas purchased from works outside of the town limits.

The electric station, built little more than one year ago, is 101 by 103 feet on the ground, and one story high, with basement. A brick wall divides the main floor of the station into two parts, one part being used as a boiler room and the other for the engines and dynamos. The outside walls of the stations are brick, the floor

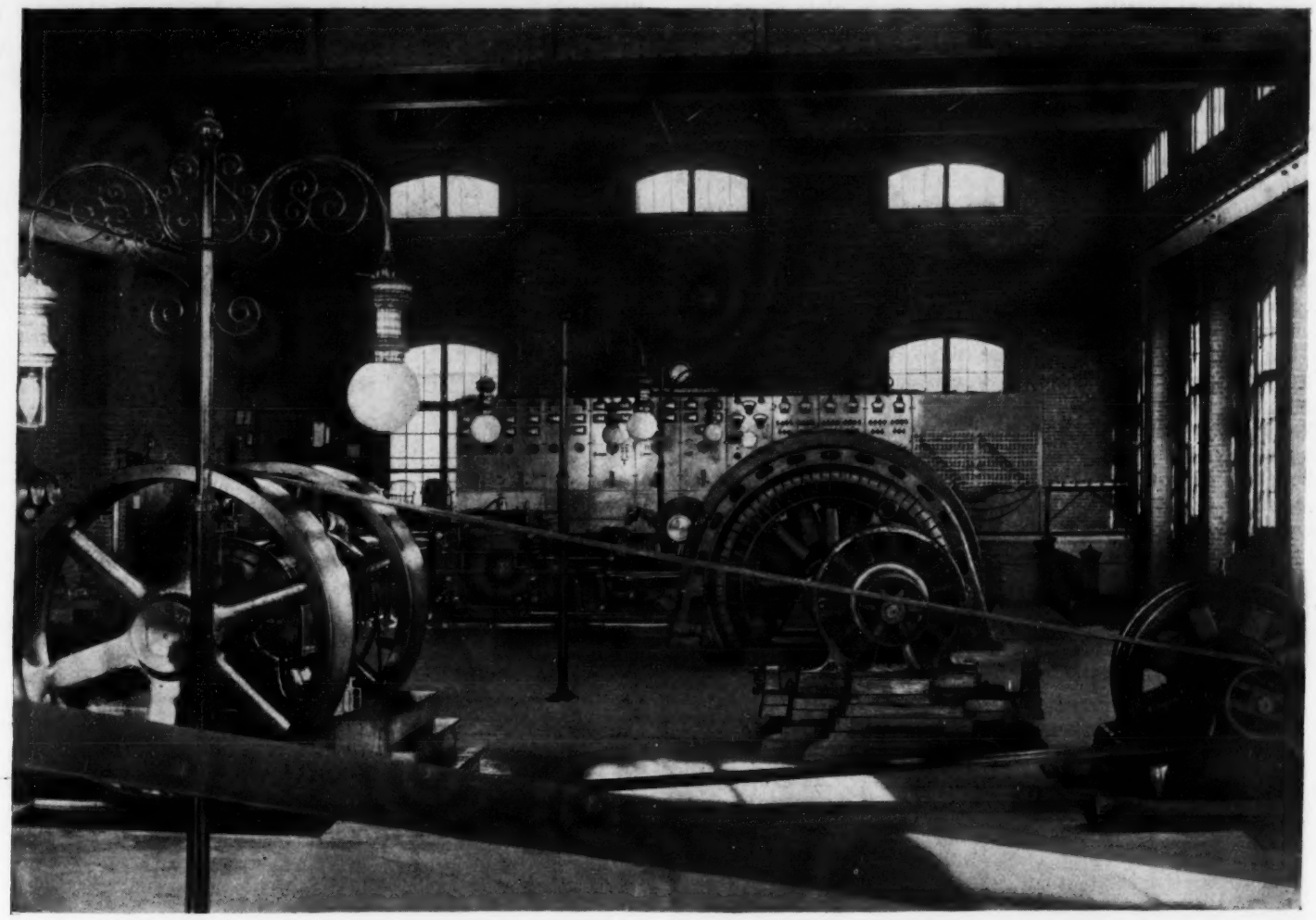


FIG. 1.—INTERIOR VIEW OF REVERE CENTRAL STATION.

cement, and the roof is supported on iron trusses. At one end of and exterior to the building is a brick chimney 187 feet high and of 7.5 feet inside diameter. This chimney furnishes natural draft for the boilers. A traveling crane, operated by hand, with a capacity of 15 tons, sweeps the entire length and width of the engine and dynamo room.

The boiler plant comprises two Stirling, water-tube boilers, each with 374 tubes of 3.25 inches diameter, and rated at 300 horse-power. Also one Hodge tubular boiler, 72 inches in diameter, containing 138 three-inch tubes, and rated at 125 horse-power. The total boiler horse-power is thus 725. The boilers are usually operated at 135 pounds gauge pressure.

The steam engine equipment comprises one Rice & Sargent tandem compound, cylinders 14 x 28 x 36, operating at 150 revolutions; one Armington & Sims' engine, cylinder 18½ x 18, operating at 200 revolutions, and one McIntosh & Seymour engine, cylinder 18½ x 18, operating at 200 revolutions. The condenser for the 14 x 28 x 36 compound engine is of the jet type, with vertical beam air pump; size, 9 x 12 x 20. This condenser was made by Geo. F. Blake Manufacturing Company, and is located in the basement of the station. Water for condensing purposes is obtained from the Atlantic Ocean, as the station is within 100 feet of the sea wall.

Three alternators, made by the General Electric Company, are driven by these engines. A dynamo of 400-kw capacity, 60-cycle, three-phase, at 2,300 volts, is direct connected to the largest engine. A 100-kw, 60-cycle, three-phase, 2,300-volt dynamo, at 900 revolutions is belted to one of the other engines. The third generator, of 180-kw capacity, 60-cycle, single-phase, 2,300-volt, at 600 revolutions, is belted to the remaining engine.

One of the exciters for these generators has a capacity of 30 kw, at 125 volts, and is direct-connected to a three-phase induction motor of 40-hp. The other exciter has a capacity of 17.5 kw, at 125 volts, and is belted to a Westinghouse engine, with cylinders 7.5 x 7, operating at 392 revolutions, and rated at 36 hp. The usual mode of excitation is with the motor-driven dynamo, and the engine-driven exciter forms a reserve.

At one end of the dynamo room, and on a platform several feet above the general floor level, a marble switchboard is mounted on a steel frame. This board contains panels with switches, indicating and recording meters for the main generators, exciters, commercial circuits and series lines for street lighting. The entire energy output of the station is metered at the board. Alternating current at 2,300 volts, 60 cycles, and either three-phase or single-phase is supplied on all of the circuits for commercial lighting.

The four constant current transformers, located in the basement, have capacities of 60 kw and 6.6 amperes each. Arc and incandescent street lamps, operated by these transformers, are arranged on separate circuits, but these circuits are at times combined on the switchboard so as to bring both arc and incandescent lamps onto the same transformer. All of the incandescent street lamps are rated at 25 candle-power and 6.6 amperes each. Transformers connected to the distribution lines of the system are as follows in numbers and capacities:

Watts.	*Number.*	*Watts.*	*Number.*
600	2	4,000	3
1,000	108	5,000	25
1,500	75	7,500	25
2,000	5	10,000	11
2,500	23	15,000	4
3,000	2	30,000	2
3,500	2		

The total number of these transformers is 267.

All of the arc lamps operated from this station are of the enclosed type for alternating current, whether used on the streets or for commercial purposes. All of the incandescent street lamps are of 25 cp.

In the town of Revere, 89 series enclosed arc lamps, of 2,000 nominal candle-power each, and 147 series incandescent lamps are operated on the streets. In Winthrop the number of 2,000-cp enclosed series arcs used for street lighting is 80, and 144 series incandescent lamps are also employed for a like purpose. During the summer months about 95 series enclosed arcs and 100 multiple enclosed arcs are operated on the Crescent Beach State Reservation, in the town of Revere. The State Bath House, at Crescent Beach, also uses about 1,500 multiple incandescent lamps during the bathing season.

In Revere the number of commercial incandescent lamps supplied by the electric lighting system is about 9,000, and in Winthrop the corresponding number is 14,000, making a total, with those at the State Bath House, of 24,500 commercial incandescent lamps. The total number of series enclosed arc street lamps named above is 264, and to this must be added the 100 commercial arcs, giving 364 connected to the system. The whole number of series incandescent street lamps is 291. To operate the commercial lamps 262 transformers are in use, and 829 meters record the energy delivered to consumers.

The distribution system connected with this station includes 1,249,693 feet of overhead wire. This wire is suspended on 1,808 poles, and extends over 52 miles of public streets. Owing to the fact that the towns in question are to a large extent summer resorts, this being especially true of Crescent Beach, the heaviest loads come in the month of August. Last year the amount of the maximum load was 720 kilowatts, which represents a slight overload for the present dynamo capacity. Besides a condenser for the compound engine

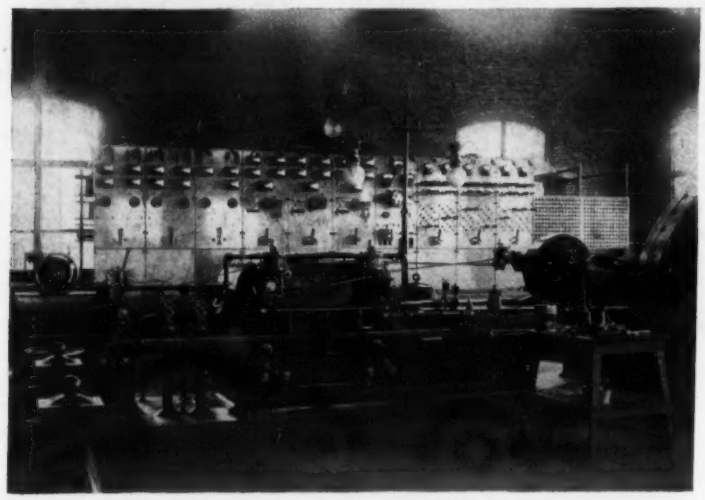


FIG. 2.—VIEW OF SWITCHBOARD.

and the constant current transformer, the basement of the station contains tub and shower baths for the employees of the company.

Month. 1901.	*Mechanical hp-hours output.*	*Pounds water evaporated per pound of coal.*	*Pounds of coal per mechanical hp-hour.*
November	137,359	8.75	2.80
December	180,081	9.05	2.53
1902.			
January	176,200	9.22	2.57
February	116,976	8.40	2.78
March	108,134	8.01	2.90
April	98,956	8.30	2.88

The above table is a record of the output and efficiency of the electric stations from November, 1901, to April, 1902.

The average temperature of boiler feed water during these months was 209 degrees. This exhibit of efficiency is instructive as showing what can be done by good engineering in even a small station. As might be expected, the smallest consumption of coal per mechanical horse-power hour was in December, the month when the output of energy was the largest.

The Suburban Gas & Electric Co. began to lay gas mains April 18, 1901, and had gas in them on November 14 of the same year. During the period between these dates 18.63 miles of pipe were laid

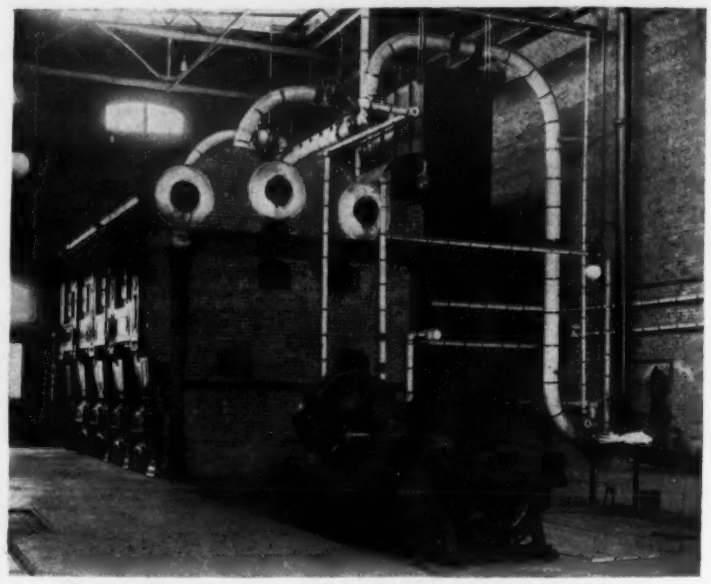


FIG. 3.—BOILER PLANT.

in Revere and Winthrop, ranging from two inches to ten inches in diameter. Besides this, 525 services were laid, 400 meters set and 250 gas stoves put in. Applications to the number of 800 have been received for gas. The Suburban Company makes no gas, but takes its supply from the East Boston Gas Company, and charges consumers $1.20 net per 1,000 cubic feet, only 20 per cent. more than the Boston rate.

Credit for the electrical features of this model station is due Mr. F. C. Sargent, the chief electrician of the company, who has kindly furnished the foregoing facts.

The Effect of Electric Waves on the Human Brain.

BY D. MCINTOSH AND J. GRAHAM-WILLMORE.

UNDER the above title there appeared in the ELECTRICAL WORLD AND ENGINEER of Feb. 22, 1902, an article, by Mr. A. Frederick Collins, in which the author gives an account of experiments which show that human brains, as well as those of living and dead animals, are sensitive to Hertzian waves, in that they exhibit the well-known "coherer" effect; and from these results draws conclusions regarding the effects which electrical storms can have on human beings, supporting his contentions with results which have come under his notice.

These results seemed to us so very interesting, and at the same time the experimental methods seemed so defective—since Mr. Collins in testing the coherer effect had used a telephone, an instrument gauged by an organ having much less discriminating sensibility than the eye—that it appeared worth while repeating the work, with apparatus which left small possibility of error.

The apparatus for generating the waves was that ordinarily employed, and consisted of an induction coil operated by three accumulators. The secondary terminals were brass balls, about two centimeters in diameter, and the spark-gap during the experiment ranged from two to five centimeters. The terminals were directly connected to two plates made of sheet zinc, having a combined area of one square meter.

In order to detect the waves and to test the apparatus before each set of experiments, coherers filled with metallic particles with the usual terminal wires, consisting in this case of brass rods seven

feet long, were employed; and to eliminate effects due to distance,* experiments were made with the coherers, four, ten and twenty-five feet from the induction coil.

In series with the coherer were placed an accumulator and a Weston millivoltmeter, reading by aid of its shunt currents to milliamperes. The resistances of the coherers, which were carefully measured by means of Kohlrausch's apparatus, were in case of the three used, between thirty and forty-five thousand ohms. These resistances changed after the passage of the waves for ten seconds to four and one-half, five, and five ohms, respectively.

Since we know the brain to consist of moist material, and the passage of electricity through it to be due to electrolytic conduction, it seemed not out of place to try the effect of Hertzian waves on solutions. For this purpose two solutions were used: one of zinc sulphate between amalgamated zinc electrodes, so as to avoid polarization currents† and enable the resistance to be measured with a Wheatstone bridge; and the other, a normal (0.6 per cent.) solution of sodium chloride between platinum electrodes. The cells containing these solutions were substituted for the coherers and the coil started.

Although these resistances could be measured to within one-tenth per cent., the Hertzian waves could not be found to have any effect.

In our experiments on brains, two pieces of apparatus for making contact were employed. The first consisted of two stout platinum plates, platinized to facilitate conductivity measurements, sealed into glass tubes and arranged on a frame so that the distance between them might be varied; the second was made of two platinum wires sealed into glass tubes and kept exactly one millimeter apart. The resistances were measured either by the ammeter (with a potential difference of from two to twenty-three volts), or by Kohlrausch's apparatus, the current in either case flowing for only a few seconds.

The following experiments were performed:

A cat was anæsthetized with ether, an incision made in the median line and the bone cleared of the occipito-frontal aponeurosis. A hole (2 cm in diameter) was then drilled in the parietal bone not far from the median line. The membranes were then cut away, the surface of the brain swabbed clean and dry, and the electrodes were introduced, at first at a distance of .75 cm apart and afterwards 1 mm apart, so as just to penetrate the grey matter. The coil was then turned on, but absolutely no change in the deflection of the ammeter needle was observed, nor could any change in the resistance be noticed when measured by Kohlrausch's apparatus. The electrodes were then introduced into the subjacent white matter. This also gave a negative result. The electrodes were then pushed downwards and slightly forwards and inwards to a distance of about 3 cm, so as to reach the grey matter of the basal cerebral ganglia. Here again no deflection was observed.

During this experiment the cat was kept fully under the influence of the anæsthetic, *i. e.*, the anæsthetic was pushed to the usual "anæsthetic" or operative stage, as shown by the respirations being normal, the pulse slightly quickened and the corneal reflex abolished. At no time, however, did the cortex fail to respond to the stimulus caused by the make and break of the current.

A fresh human brain, with the meninges practically intact (1161.5 gms. weight), from a woman just recently dead from cancer and absolutely free from contamination with any antiseptic, was the next subject for experimentation. It will be remembered that Mr. Collins affirmed to have obtained the most marked coherer effects with this material, and in view of this hopes were entertained for a refutation of the negative results obtained in the previous experiments. These hopes were, however, speedily shown to be vain, as in no part of the cerebrum, cerebellum or medulla, in spite of the most elaborate precautions, were observed the phenomena so definitely described by Mr. Collins. The dura and arachnoid were dissected off, the cerebral surface carefully dried of cerebro-spinal fluid and the electrodes inserted at a distance of 1 mm apart into the following portions of the brain:

1. Cortical grey matter of the ascending frontal gyrus, near its termination.

2. Subjacent white matter, the grey having been previously sliced away in this region.

3 and 4. Cortical grey and subjacent white matter of Broca's convolution.

5 and 6. Cortical grey and subjacent white matter of gyrus angularis.

7 and 8. Cortical grey and subjacent white matter of superior temporal sphenoidal gyrus.

9 and 10. Cortical grey and subjacent white matter of ascending parietal gyrus, at about the level of the center of the Rolandic fissure.

11. The internal capsule, both of the motor (anterior limb) and sensory (posterior third) portions.

12 and 13. Grey matter of the optic thalamus and caudate nucleus.

14. The striæ acusticæ on the floor of the fourth ventricle.

15 and 16. Cortical grey matter and white matter of the arbor vitæ of the cerebellum.

17. As accurately as possibly, the granular or rust-colored layer of the cerebellum, which Mr. Collins found the most sensitive of all portions of the encephalon.

18. Various parts of the pons, including most of the nuclei of the cranial nerves situated therein.

A happy coincidence enabled the observers to endeavor to reproduce Mr. Collins's results during a somewhat violent thunderstorm, which broke over Montreal during the noon of April 26th. A pigeon was hastily decapitated—the first animal at hand, since it was impossible to foretell how long the storm would last—the electrodes placed in position in its brain and the ammeter carefully watched during the entire course of the storm for a deflection of its needle. Unforunately negative results were again encountered, as though several flashes occurred, not the slightest trace of any cohering action in the brain was observed.

It may be objected by Mr. Collins that the brain of a pigeon is so low in the scale of evolution—and his most remarked results were with the highest brains—that no reaction could be possibly expected. If, however, a short excursion into the realm of theory be permitted, it might be argued that Mr. Collins explains the indisputable power that various individuals have of predicting the advent of an electrical storm, upon the ground that the brains of these individuals are specifically affected by the advance guard of Hertzian waves sent out by that storm; that this condition, when the higher psychic centers were alone affected, resulted merely in fear or a vague feeling of uneasiness, but that when the medullary vital centers were affected it resulted in some pathological condition varying from pain to actual death itself.

It has often been noticed that upon the approach of a storm, long before the first flash be seen or the first distant roll of thunder be heard, that birds show unmistakable signs of fear, or of a premonition of evil; they suddenly become hushed, not a note of song is heard, and they all huddle together as if for sympathy or mutual protection. Surely the same agency, whatever it may be, must be at work upon the brains of birds and upon susceptible human beings. If so, it seems reasonable to argue that the brain of a bird should be a singularly fit subject for an experiment of this nature.

A cat was again chosen for the next experiment; it was decided to ascertain whether or not the depressing action of the ether upon the sensorium was responsible for the negative results hitherto obtained. Accordingly, after exposing the brain in the usual manner in the ectosylvian region, the electrodes were inserted and a preliminary trial made, with as before, a negative result. Upon this occasion Dr. Wesley Mills, professor of physiology in the university, kindly lent his presence both as an impartial observer of the phenomena manifested and in the capacity of an expert superintendent of their physiological aspect. The cat was then allowed to recover from the anæsthetic until all reflexes were established and a certain amount of voluntary movement noted.

The grey cortical matter, the white, the internal capsule, and the basal ganglia were then in turn tested, with, as before, absolutely negative results in each case. The bone was then replaced—the cat

* Bose, London *Electrician*, 776, 864, 897. 1901. *Phil. Trans.*, 1910.

† We might mention here that the astonishment of Mr. Collins in finding difficulty in measuring the resistance of a brain (an electrolyte) by means of a Queen testing set, will not be shared by those who have attempted to measure such resistance with a direct current. The sudden swinging of the galvanometer-needle when an approximate balance was obtained is due, of course, to polarization currents, and is probably not affected by atmospheric electricity. Such measurement can be made accurately and rapidly by means of an alternating current and telephone. (See Kohlrausch and Holborn; "Leitvermogen der Elektrolyte.")

being then under the influence of more ether—the wound sewn up, dressed and the cat allowed to recover.

En passant, it may be observed that during this operation the characteristic twitching of the muscles mentioned by Mr. Collins, as occurring only during the emission of the waves, was repeatedly noted. This twitching, as any anæsthetist knows, is by no means uncommon; it occurs either at the commencement of, or more usually during the recovery from anæsthesia, and it seems unnecessary in this case to call in the aid of electricity to explain what is, after all, a purely pharmacological condition.

The various functions of the brain have been regarded as controlled by centers, each of which has its own work and definite status in the economy of the organism. These "centers" are susceptible to the action of drugs, particularly to the depressing action of the alcohol group, to which ether belongs. In each case the highest—or more lately evolved—centers are the first to be influenced, the lowest, the great vital centers of the medulla, the respiratory, cariac and vaso-motor centers, are among the last. This must necessarily be so, since they are essential to life.

The action then of ether consists in a transient stimulation, followed by a progressive depression and later paralysis of these centers, in a descending order—the highest being the most susceptible are also the last to recover their normal functions.

Voluntary motion of all kinds may be regarded vaguely as the composite result of two main centers, a "stimulating" of which the function is to set the neuro-muscular apparatus in operation, and an "inhibiting" which governs and co-ordinates the movements performed by regulating the nerve-impulses sent out by the former.

Among the highest centers of all are the inhibitory of all kinds, and a condition is easily conceivable in which the centers co-ordinating or inhibiting the action of those muscles, would be inactive, while the lower stimulating center—either recovering sooner or succumbing later—would have full play; this would cause in the muscles, which it supplied, an incoördination of movement, *i. e.*, it would run riot.

This is well shown in the talkative delirium of a patient recovering from ether, in which spasmodic contractions of other muscles are an earlier symptom; the freedom of speech of a man under the influence of alcohol is also another case in point. Moreover. similar twitching—amounting in some instances even to convulsions—is seen in cases where there is an anæmic condition of the brain from any cause, resulting in imperfect nutrition. Mr. Collins seems to have been much impressed, too, by the death of a delicate and nervous child, occurring immediately after a flash of unusual severity, and to regard mere fright as a by no means sufficient cause therefor. Mr. Collins may, or may not, be aware that death from "psychic shock" is by no means an uncommon accident, under conditions which absolutely preclude the very possibility of atmospheric disturbances being the causative agent.

Death in these cases is usually due to a sudden reflex depression of the medullary centers—any kind of sudden mental impression, provided it be of a sufficiently violent nature, proving an effectual initial stimulus. Thus patients often died, in præ-anæthetic days, immediately upon the first incision, and one case, at least, is on record in which a French surgeon (Desault[1]) "drew his finger-nail over the perineum of a patient to mark the line of incision, when the patient suddenly gave a cry and was dead." Cases of this nature tend most strongly to the conclusion that fright, and fright alone, can cause death.

In conclusion, the theory advanced by Mr. Collins as regards the peculiar nervous phenomena evidenced by various people, especially those of a neurasthenic disposition, during an electrical storm, is undoubtedly most suggestive; but the present experimental evidence seems to show it to be far too speculative for it to be regarded even in the light of a working hypothesis.

It only remains for the writers to express their sincere and heartfelt thanks to Professor Rutherford and Professor Wesley Mills for the loan of apparatus and much kindly interest and encouragement.

[1] Sollmon. Textbook of Pharmacology.

Electric Light in St. Paul's, London.

A private view of the electric lighting of St. Paul's Cathedral, in London, was given to press representatives on May 28. It is stated that the light is distributed in a very effective manner. The entire installation is not yet completed however.

The Guarini Automatic Wireless Telegraph Repeater.

BY A. FREDERICK COLLINS.

IN the ELECTRICAL WORLD AND ENGINEER, under date of March 29th, there appeared in the column of Current News and Notes an interesting paragraph, entitled, "A Wireless Telegraph Relay," which read as follows: "The steamer *Philadelphia* of the American Line, which arrived last week at New York, was the 'repeating station' of the Cunarder *Campania*, racing with her for New York, and the Cunarder *Lucania*, bound for Queenstown. It was in latitude 42.02 to 44.30 and longitude 38.40 to 40.30 that the experiment was made, and it was satisfactory. Many messages were relayed by the *Philadelphia* in both directions. The *Campania* caught the American about 90 miles away. Knowing that the *Lucania*, eastward bound, was somewhere in the zone, the *Campania* tried to reach her but failed. Then she asked the *Philadelphia* to signal, and as soon as the American liner caught her the 'relay system' became a fact."

This tells in a few words the story of a pretty experiment as well as describing the first attempt to repeat wireless messages on the high seas; incidentally it dawns upon the reader the value of equipping vessels with the necessary apparatus for automatically relaying them. In the case cited, the cableless messages were received by the operator on the *Philadelphia*, who, when the opportunity presented, retransmitted them in the regular course of procedure, which naturally required a considerable length of time before the two extreme vessels were in communication, one with the other, but the results showed clearly the possibilities, if not, indeed, the absolute necessity, of devices for relaying messages automatically.

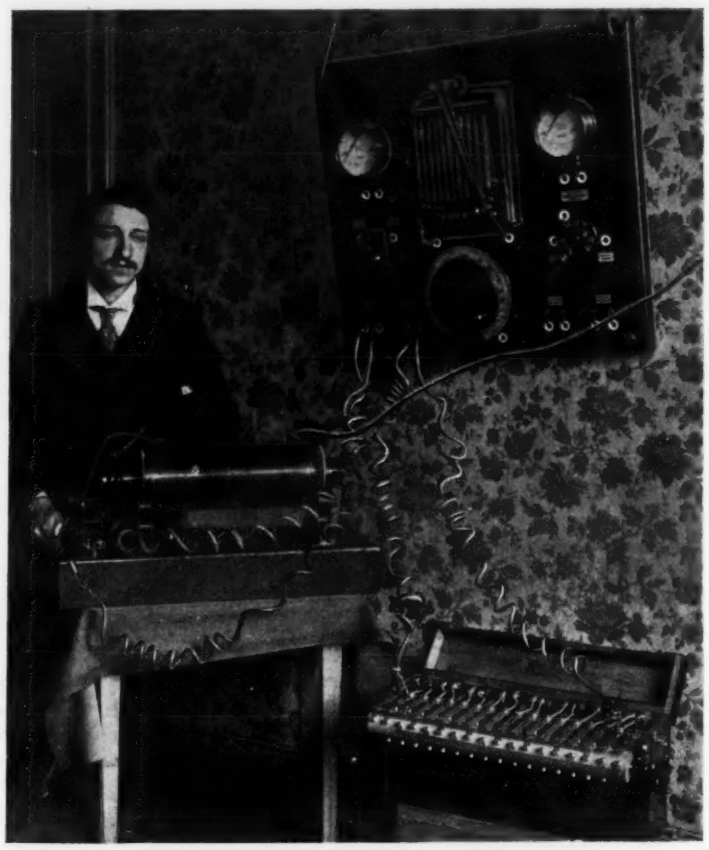


FIG. I.—TRANSMITTER AT BRUSSELS STATION.

An automatic wireless telegraph repeater fulfilling the conditions required for trans-oceanic service has been invented by M. Emile Guarini, of Brussels, Belgium, who, with the assistance of Artillery-Lieutenant Poncelot, made some exceedingly interesting experiments in 1901 between the cities of Antwerp and Brussels, a distance of 25 miles, with the repeater located midway at the village of Mechlin.

M. Guarini has described the experiments in the ELECTRICAL WORLD AND ENGINEER, of August 3, 1901, but I am not aware that he made known the construction of his apparatus, which is here appended.

The difficulties encountered in combining a wireless transmitting

apparatus with a wireless receiving device so that the powerful outgoing radiation of the former may not conflict with—or what is more likely—annihilate the feebler incoming train of electric waves will be at once apparent to the veriest tyro, and to those who have worked along these lines the task will assume stupendous proportions.

In wireless telegraphy, it is well known, that when the transmitter is in action the receiver is cut off completely from the antenna or vertical wire by means of a switch and the reverse. The principle function of a wireless repeater must resolve itself into an electro-mechanism that will automatically, at every impulse received by the coherer attached to the antenna, operate to cut out the antenna and then throw into contact the secondary terminal of the transmitter and close the circuit operating the primary of the induction coil. All this must be done with a rapidity the time value of which should be measured by the one-hundredth part of a second.

Before describing the repeater proper, let us commence at the Antwerp station, the antenna of which is suspended from the tower of the Cathedral of Notre Dame, and follow in detail a new method originated by Guarini for transmitting a message without wires, and where waves longer than any heretofore deemed available are propagated to the Mechlin station, and there received, translated into waves of much shorter length and re-transmitted to Brussels, where they are finally received.

The new form of transmitter is similar in many respects to the one designed by Edison in 1888, but the coherer was yet to be invented, and it remained for Guarini to discover the effects of an alternating current of low frequency on metal filings. The transmitter is shown in Fig. 1, with Guarini at the key. The coil is of the ordinary Ruhmkorff type, with mechanical vibrator; this is operated by a 12-cell storage battery, shown to the right; the current thus derived is led to the switchboard, on which are placed a voltmeter, ammeter and the necessary resistance coils, and then to the primary winding of the induction coil.

It will be observed that there are no oscillator balls attached to the secondary terminals of the induction coil, but that the antenna and "ground" wire are connected in alignment with the secondary of the induction coil; in other words the principal part of the oscillator-system forming the basis of the popular conception of etheric wave wireless telegraphy is missing, as there can be no high-frequency oscillations take place in the antenna since there is no disruptive discharge to set up such oscillations.

The Guarini transmitter is similar in many respects to one designed by Edison in 1888, but the coherer was yet to be invented, and it remained for the Belgian inventor to discover the effect of an alternating current of low frequency on metal filings. When the transmitting coil is in action alternating currents of high potential surge through the secondary, antenna and ground wire, and although the frequency of the pulsations are low, being synchronous with the make and break of the interrupter, long electrical waves are radiated that have evidently the same effect on metal filings that the shorter waves emitted by a high-frequency oscillation due to a disruptive discharge have. This method is a radical departure in electric wave propagation. The waves thus propagated were received at the Mechlin station and were translated by the automatic repeater into re-energized waves.

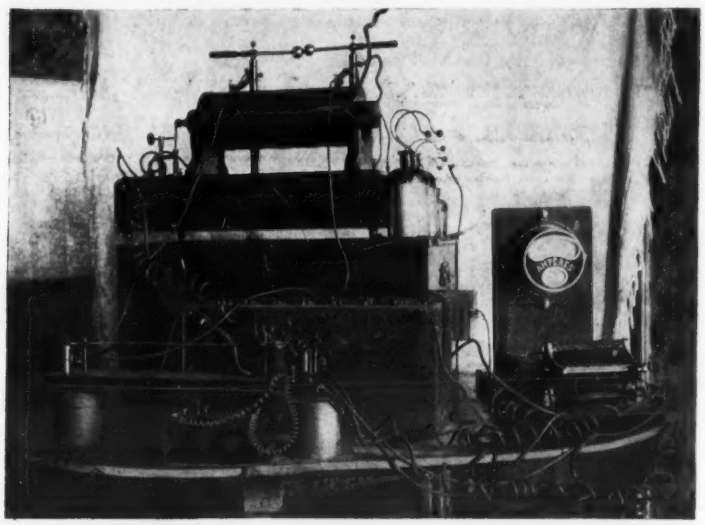


FIG. 2.—GUARINI AUTOMATIC REPEATER, MECHLIN STATION.

Fig. 2 shows the repeater reproduced in half-tone, and Fig. 3 represents the arrangement of the apparatus in diagram. A single antenna, 1, is employed to receive and transmit the Mechlin messages; a special relay, termed an aerial switch, 2, provides the means for automatically cutting off the antenna from the high-tension secondary current of the coil 3 when the receiving apparatus is brought into play and *vice versa*.

The induction coil the operator employed here was equipped with

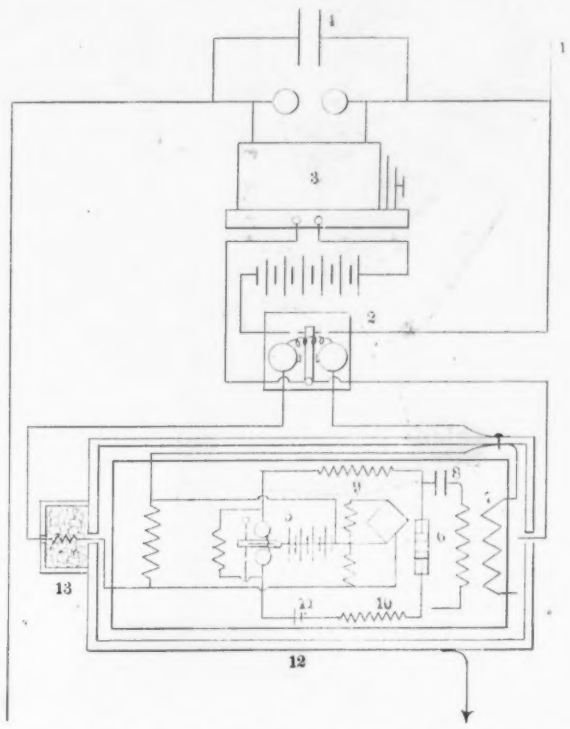


FIG. 3.—DIAGRAM OF GUARINI AUTOMATIC WIRELESS REPEATER.

oscillator balls, and gave a maximum spark of 25 cm, with a current of 3 amperes at a potential of 30 volts. The spark was cut down to 5 mm, and a condenser 4 is placed in shunt with the spark-gap to "diminish the normal length of the spark, and consequently the travel of the interrupting electromagnet" of the switch 2. So much for the transmitting device. In the receiving portion of the repeater a second relay 5, of exceeding sensitiveness, is introduced and placed in series with a Blondel regenerable coherer 6, the platinum surface contacts of this relay were insufficient to carry the necessary current to operate the transmitting coil, and to overcome this deficiency Guarini used this relay to actuate a second circuit having a greater carrying capacity.

The antenna is not connected directly to the coherer, but terminates in the primary winding of a small induction coil 7, the other end of which leads to the earth through the metal box 12. The object of this induction coil, according to Guarini, is to increase the tension of the coherer circuit. A condenser, 8, is shown in the circuit, including the coherer and secondary winding of the induction coil 7, and serves a dual purpose in that it breaks the continuity and modifies the capacity of the circuit in its relation to the inductance coils 9 and 10, the battery 11 and the relay 5.

To insure the proper protection of the apparatus from extraneous electric waves the coherer and its attendant decohering tapper are enclosed, together with the relay, inductance coils, condensers and all wires over which such waves could be led to the coherer, in a metal box, 12; the relay is especially protected by a special inductance coil in an iron box.

The second relay, or aerial switch, occupies a position outside the metal casings, as the spark found in breaking contact sends out trains of miniature waves sufficient to close the circuit should they reach the sensitive coherer. The aerial relay 2, Fig. 3, as well as the antenna which is connected with the primary winding of the coherer induction coil 7 is protected from the untoward effects of extraneous waves, due to atmospheric electricity, by several ingenious methods; for instance, in Fig 2, the aerial relay will be seen in the foreground resting on two cylindrical boxes, the armature with

the attached lever is 30 cm in length and is divided into no less than three parts with the metal portions insulated one from the other by hard rubber plates. The first metal bar forming a portion for the heavy current operating the coil, the second bar forming the armature for the relay magnets, and the third bar acting as an interrupter for the antenna.

Where the juncture is effected between the antenna and the primary of the coil 7 it is well insulated and then enclosed in a sheath of iron

FIG. 4.—DECOHERER.

tubing having a ground connection for the purpose of leading foreign waves to the earth. In testing the value of different metals for this use Guarini found that electric waves permeates lead tubing even though it may be 2 or 3 mm in thickness. A triple contact is employed in the aerial switch for obtaining greater precision in operation than would be possible with a single contact.

The relay 5 is of the Siemens polarized type, but modified to suit the requirements of the repeater in that the T-pole is insulated from its armature. It is exceedingly sensitive, requiring but one-twenty-thousandth of an ampere to move the armature to point of contact and closing the circuit. The Blondel regenerable coherer, shown in the photograph, Fig. 4, consists of a glass tube with conductor plugs having parallel faces as in the ordinary forms, but also has an additional U-shaped tube blown midway in the tube and at right angles to it. This inverted U-tube is considerably longer at the free end than the one forming the juncture with the coherer tube proper. In the lower free end of the U-tube there is an additional supply of the metal filings for the purpose of increasing the amount in the coherer pocket, or by turning the U-tube and coherer around the axis of the latter the amount of filings may be decreased without destroying the vacuum and re-exhausting the tube each time a change is made. Guarini prefers fine filings of silver and nickel enclosed in a pocket between the electrodes or conductor plugs, 5 mm in length; this renders the sensitiveness of the coherer very great, since its sensibility depends largely upon the pressure and quantity of the filings which decrease with the size and oxydization of the latter. The standards for holding the coherer in position are arranged so that the tube may be removed and another inserted with ease and expediency, and at the same time when once set is perfectly rigid. To remedy the trouble often caused by a broken terminal wire of the coherer connected with the conductor plugs, the inventor has designed special copper cylinders which slide over either end of the coherer tube, the inner surface of these forming contacts with the plug terminals and from the cylinders heavy wires lead to the binding posts, as shown in Fig 4.

A single dry cell is sufficient to operate the polarized relay through the coherer; if, on the other hand, there is an excess of current, on every tap from the decoherer, the effect on the filings is practically the same as an interruption or break in a direct current, except in the case of the coherer filings they are multiplex; the spark taking place between any two particles of the filings causes them to act as oscillators, sending out miniature trains of waves which react on themselves, and re-cohesion is the result. To obviate this difficulty in the Guarini repeater the relay is started with a current operating through a total resistance of 1,100 ohms, but when the tapper strikes the coherer tube an auxiliary resistance of 2,000 ohms is automatically added and thus decoherence occurs upon very slight strokes with a very weak operative current; both of these features tend to lessen the oscillatory action of the filings.

The decoherer, Fig. 4, is of the single-stroke, electro-mechanical type, arranged with a spiral spring and screw, giving a micrometer adjustment, permitting strokes of any required degree. It is one of the simplest and most efficient modifications of all decohering devices yet invented.

The repeater is absolutely automatic in all its functions, and from the instant the feeble radiation from a distant station falls on the antenna, through all the succeeding translations from the coherer to the powerful re-energized waves emitted from the same antenna, no human hand is required to assist it.

If the regular trans-Atlantic service were equipped with these repeaters, messages could at all times be relayed between England or the Continent and the United States, thus establishing a cableless system of telegraphy that would be at once practical, efficient and, what is more to the point, commercial. In this case the additional attachment of a Morse printer could be easily applied, so that each vessel might have, indeed, its own daily paper with the very latest news, including stock quotations and society gossip, so that life for a week on the ocean would no longer be the dull routine of promenade on deck and perusal of copyright fiction that has heretofore marked it, but up-to-the-minute mode with each passenger buried behind the *Atlantic News* during his breakfast hour. All this is not only possible, but extremely probable, and that within a very short time. The writer is informed by M. Guarini that negotiations have

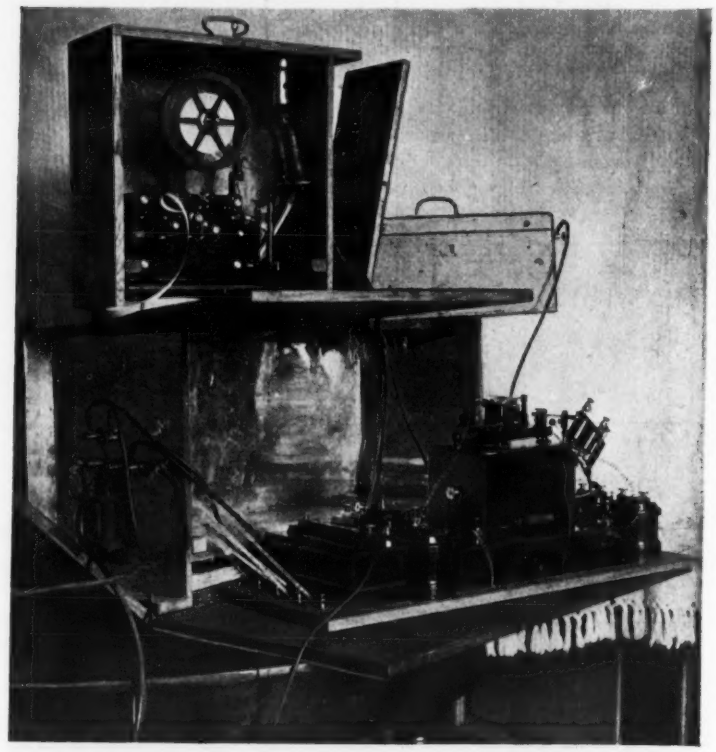


FIG. 5.—RECEIVER.

been entered into between himself and the Marconi interests to bring about such conditions as referred to above, but the outcome has not yet been made public.

To return to the Antwerp-Mechlin-Brussels system, where the messages have been received and retransmitted by the automatic repeater at Mechlin, it is finally received at Brussels by the arrangement shown in Fig. 5. The apparatus consists of essentially a coherer and decoherer, as in the repeater just described, together

with the Siemens polarized relay, inductance coils and condensers, all of which are placed in a metallic case connected with the ground. A Morse recording apparatus with a special resistance coil in a wooden case completes the receiving equipment.

Guarini has been an assiduous worker in his endeavors to ascertain the most suitable form of antennæ. He has experimented with many kinds, and finally selected the following as best suited for the purpose: At both the Brussels and Antwerp stations the antennæ assumed the form of a cylinder composed of fifty parellel wires, the diameter measuring 50 cm and the length 10 m. These were suspended from the tower of Notre Dame Cathedral and Column of Congress by means of a cable of copper wires. The antennæ at the repeating station at Mechlin terminated in a cylinder of wires, as in the case of the two principle stations, but was suspended at a heighth of 70 m above the level of the sea, against 80 m as arranged at the Brussels station. It has been demonstrated by the inventor that antennæ constructed according to these specifications are excellent radiators though the damping co-efficient is large, the oscillations producing only one and one-half to two complete swings until zero is reached.

In his experiments between Antwerp and Brussels, Guarini's object was not to operate commercially, though the perfect action of the installation would have warranted this, but to work out in practice his system of repeating automatically wireless messages.

Guarini has blazed the way for wireless telegraphy to any distance by his clever invention, just as Morse made it possible to operate regardless of space, over wires by means of his relay. The signs of the time point not only to trans-oceanic wireless telegraphy by means of repeaters, but to revolutionary methods of overland wireless telegraphy, in military operations, where storms have destroyed the aerial wires, and for everyday commercial use as well.

European Polyphase Railways—I.

In a paper read last week before the American Institute of Electrical Engineers, Mr. Carl L. DeMuralt gave an account of some of the more important polyphase railway systems that have been installed or experimented with in Europe.

The first systematic tests with alternating current traction in Europe were made by Siemens & Halske, of Berlin, in 1892, in Charlottenburg on a specially constructed track of about 360 m. length, with one curve of 40 m. radius. There were two overhead trolleys, the rails forming the third conductor. The voltage was between 500 and 600, the periodicity 50 cycles per second. An open car was used on an ordinary street railway truck, equipped with a three-phase induction motor driving one of the axles by means of a single reduction gear of 1 : 11. The speed of the motor being 1,400 revolutions per minute, the maximum speed attained was about 25 km. (15 miles) an hour.

The primary winding of the motor was arranged to allow being connected in delta for starting purposes, whilst it was changed to star connection for full speed. The starting torque of the motor was therefore made about six times the full load running torque. The motor was also provided with slip rings on the rotor, which allowed for inserting resistance into the secondary winding.

These tests showed clearly that an alternating current railway was absolutely feasible, and proved that no serious difficulties would be encountered in regard to the trolley line construction. However, the street railway problems then under consideration did not absolutely require the use of anything else but the use of the well-known continuous-current system, and this is probably the reason why these tests were not carried any further and put into actual practice.

The installation as just described was sent to the Chicago Exhibition in 1893, where it attracted considerable attention, but nothing has been heard of it since.

Lugano Tramways.—Brown, Boveri & Co., of Baden, Switzerland, may claim the honor of first putting alternating current into actual use for traction on a commercial scale. The tramways of Lugano, the first three-phase railway, were opened for traffic in 1895. The power station for these tramways is 12 km. outside of the town, therefore transmission with 500-600 volts continuous current was impossible. Rotary converters seemed too expensive, and thus it happened that all conditions were favorable for an experiment with three-phase alternating currents. The total length of the line is 4,900 m. (about 3 miles), with maximum grades on long stretches of 3 per cent., and on short stretches of 6 per cent. The transmission voltage is 5,000 volts at 40 cycles. Transformers reduce this to 400 volts. Two trolley wires of 6 mm. diameter, 25 cm. apart, are used, and the rails serve as third conductor. The cars hold twenty persons each. There is one 20-hp motor per car, completely enclosed, with single reduction gear 1 : 4. The speed of the car is 15 km. (9.3 miles) an hour. Two trolleys, one 1 yard behind the other, make contact with the two lines. Motors are started by means of a reversing switch, and their speed is controlled by means of a resistance in the rotor circuit. Cars can be handled from both platforms.

Fig. 1 gives a good idea of one of these cars, and shows part of

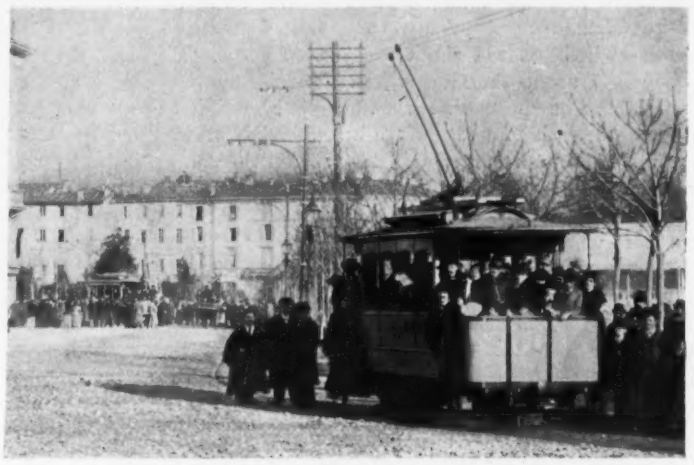


FIG. 1.—CAR ON LUGANO RAILWAY.

the line. Tests have demonstrated that it is possible to start with ease, even on 6 per cent. grades and under more than full load.

Gornergrat Railway.—After the Lugano plant had thus proved that alternating currents could be applied to ordinary tramway purposes, the Gornergrat road was destined to show that they could also be used to advantage on a much larger scale and under the most severe conditions met on a Swiss mountain road. The total length of this line is 9 km. (5.6 miles). The difference in altitude of the two terminals is 1,412 m. (4,660 ft.). The maximum grade is 20 per cent., the minimum radius in curves 80 m. The gauge is 1 m. (3 ft. 3⅜ ins.), with an Abt rack between rails. The power station generates 5,400 volts at 40 cycles. Three transformer stations of 180 kw, each 2, 5 and 8 km. respectively from the beginning, reduce from 5,400 to 540 volts. The high-tension line follows a separate route. The trolley line consists of two wires of 8 mm. diameter suspended by means of cross-wires from wooden poles every 25 m., the rails forming the third conductor. The speed is 7 km. (4.35 miles) an hour, and there are five stations, 2.5 to 3 km. (1.5 to 1.8 miles) apart. The normal train consists of one locomotive, one main passenger car (sixty persons), and one second car (fifty persons) added when needed. As a maximum there are two trains up and one down on the road at the same time. The locomotive weighs 10.5 tons, two cars 9.2 tons, and 110 passengers 8.3 tons; total for one train, 28 tons. The motor capacity is therefore 160 hp, or about 180 hp on axles, and the locomotive is equipped with two motors of 90 hp each, running at 800 r. p. m. Each motor drives by means of a double gear one of the two cog-wheels. The total reduction of gear is 1 : 12. The motors are controlled by a reversing switch, through which the stator is connected to the line, and by the usual starting rheostat in the rotor circuit. The rheostat is placed on the top of the motors to save space, and the switch, fuses and instruments for the same reason on the side and against the roof of the car. Two trolleys are employed on each line wire, on account of the large current and in order to pass switches without making a break. The motors start on any grade under full load without using more current than when running at full speed and full load. They can start under more than full load, but with proportionately more current. Fig. 2 shows the truck of the Gornergrat locomotive with one of the motors in its place. This line was completed in 1897 and opened to traffic in 1898.

Jungfrau Railway.—Before the Gornergrat road was finished, work was already begun on a very similar line, the Jungfrau Railway. The total length of this road is 13 km. (8 miles), with a difference in altitude between the two terminals of 2,100 m. (6,900 ft.).

The grade, almost immediately after leaving the little Scheidegg station, is 10 per cent., and this is increased to 20 per cent. at about half-way to the Eiger Glacier Station. From there on, the grade increases to the maximum of 25 per cent., when the line enters the tunnel. The permanent way is of metre gauge, with a rack of the Strub system half-way between the rails. The sharpest curve on the open section has a radius of 100 m; in the tunnel this is increased to 200 m. Water-power is made use of in the valley of the White Lutschine to generate three-phase currents at 7,000 volts and 38 cycles, which is transmitted by overhead wires to transformer stations along the line, where it is transformed down to 500 volts. The substations are stone buildings, designed to withstand the action of the most inclement weather. They are fitted each with two 200-kw transformers. When the whole line is completed, transformers will be placed about every 1,000 yards. There is a double trolley line, as on the Gornergrat. The locomotives are very similar to those on the Gornergrat line. They weigh 13 tons complete, and contain each two 125 to 150-hp induction motors, driven at 760 r. p. m. The motor-controlling devices and the contact arrangements are exactly the same as on the Gornergrat road. The cars hold forty persons each, and a normal train consists of one locomotive pushing two cars, the total weight of such a train, when filled, being 28 tons, as on the Gornergrat road. The speed, however, is 8 km. (5 miles) per hour.

The first section of the Jungfrau Railway, to Eigergletscher, was opened in September, 1898, the second, to Rothstock, in April, 1899; since then each year has seen further progress toward the summit, which will probably be reached in five or six years.

Stansstad-Engelberg Railway.—The next alternating-current railway to be built was the one from Stansstad to Engelberg. This road, although of metre gauge only, approaches in the shape of its cars normal gauge railway conditions. The total length of the line is 22.5 km. (14 miles). The first 15 km. have small grades up to 2 per cent., the next 3 km. have grades of 2.5 per cent. to 5 per cent.; then follows a section 1.5 km. long with a grade of 25 per cent. and a so-called ladder rack, finally about 3 km. more with grades of 2.5 per cent. and less. The minimum radius in curves is 50 m. The power station is situated at the beginning of the rack section, about 18 km. from Stansstad; therefore it is near the point where the maximum energy is used. The voltage generated is 750 volts at 32.5 cycles, and this is fed direct into the trolley line. A 90-kw step-up transformer produces 5,300 volts, which is transmitted to two substations situated at about 3 and 7 km., respectively, from Stansstad, and containing each a similar transformer, reducing the

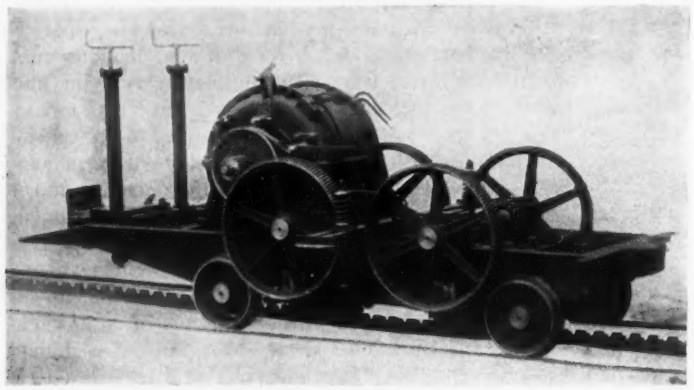


FIG. 2.—TRUCK OF GORNERGRAT LOCOMOTIVE.

voltage again to 750 volts. The trolley line construction is similar to that found on the Gornergrat and Jungfrau Railways.

There are nine passenger stations on this road. Three locomotives and seven motor passenger cars are used. The cars are of the double-truck type, and their total length is 14 m. Each car weighs 14 tons and has room for forty-six passengers, besides being provided with a baggage compartment. The front truck carries two motors of 35 hp each, running at 400 r. p. m., with single reduction for a car speed of 20 km. (12.5 miles) per hour. The contact with the trolley line is made by means of two double-contact bars attached to the roof near each end of the car. The cars can be controlled from either end platform, and the control is similar to that already described for the other roads. One automobile car is able to propel itself and to haul a trailer of about 10 tons on grades up to 2.3 per cent. The first 15-km. section which happens to have the heaviest traffic is therefore worked with two cars at a speed of 20 km. per hour. The next section, with heavier grades up to 5 per cent., is traversed by the motor car alone at the same speed, the motors furnishing about 80-90 hp for a 16-ton load on a 5 per cent. grade. At the beginning of the rack section a locomotive is added, which pushes the car up the grade of 25 per cent. at a speed of 5 km. an hour. The last stretch, with grades up to 2.5 per cent., is covered by the automobile alone.

The locomotive not only serves for the above-mentioned purpose, but is destined also to haul freight trains of 20 tons total weight over

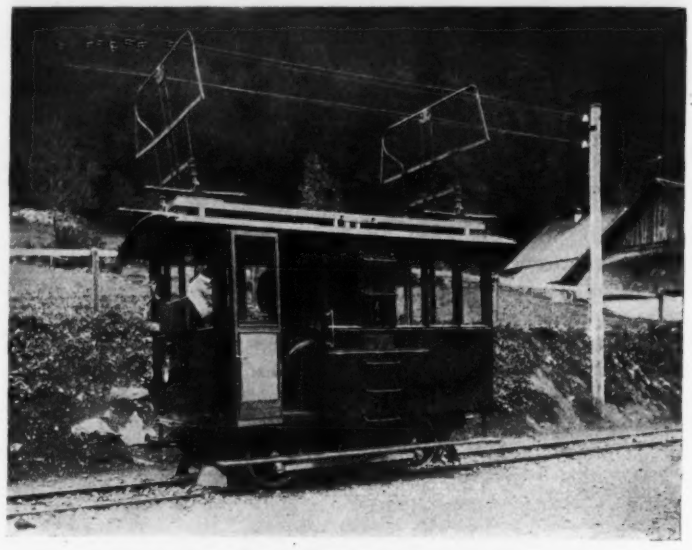


FIG. 3.—CAR ON STANSSTAD-ENGELBERG RAILWAY.

the lower part of the road at a speed of about 11.5 km. an hour. Its design, therefore, varies greatly from the Gornergrat and Jungfrau locomotives. Two motors of 75 hp each and 650 revolutions per minute drive through a single reduction gear a countershaft, which, by means of two symmetrically placed gears, drives the cog-wheel placed in the center of the locomotive. This wheel is mounted on a hollow shaft fitted over the crankshaft, which, in its turn, drives the four main carrying wheels of the locomotive. On the rack section the cog-wheel alone is driven. In the level country a friction coupling is set in such a manner that the two main axles are driven and the cog-wheel is allowed to follow loose. The contact device is similar to the one on the passenger cars. Fig. 3 gives a good idea of this locomotive. The Stansstad-Engelberg Railway was opened also during 1889.

Paralleling of Alternators.

At the meeting last week in Pittsburg of the Engine Builders' Association, Mr. H. E. Longwell read a paper entitled "The Requirements for the Paralleling of Alternators as Viewed by the Engine Builders." The first part of the paper consists mainly in criticism of the part electrical engineers have taken in the endeavor to arrive at a solution for the problem of parallel operation as affected by the prime mover. The criticism at times approaches captiousness, as in its reference to the "formidable array of mathematics, Greek letters and scientific terms" used by electrical engineers, and in an expression of satirical wonder at the mystery of electricity, the apparent understanding of which by the electrical engineer "suggests to us a superhuman intelligence."

Mr. Longwell considers that while to-day quite a considerable number of installations are operating in parallel quite satisfactorily, this has been due to dint of strenuous effort blindly applied. As to the reasons of success or failure, however, the opinions have differed so widely that it may be safely said that there is no theory that has not been attacked from some point or other. Some authorities maintain that dash-pots on the governors do the business; others that the turning moment of the engine was improved; still others will say that the use of copper pole tips or dampers on the generators is what turns failure into success. In a great many instances the difficulties experienced in paralleling alternators have been more or less completely overcome by tinkering with the governing mechanism

of the engine, and consequently it has become fashionable to say that the troubles originate in hunting, oscillating, or otherwise faulty governors. This Mr. Longwell considers an unfair statement, adding that coincidence and cause are two entirely different things. The interaction between generators is not necessarily caused by the hunting or oscillating of the governors, even though both phenomena are coexistent, and even though the latter tends to aggravate the former. A more fair statement of the case is that the parallel operation of the alternators imposes a duty on the governing mechanism of the engine which is abnormal, and which is directly opposed to its natural function. The use of dash-pots, friction brakes, etc., is justified, not because the governor is faulty, but because we must make it so to prevent its resisting the contradictory demands of the electrical part of the plant.

Mr. Longwell discusses the matter of cross-currents as affecting parallel operation, and quotes Mr. W. I. Slichter on the subject. In a paper read by the latter the statement is made that the requirement as to departure from uniform rotation has the object to limit the amount of cross-current that can flow between generators. With a displacement of 1-72 of the pitch angle between two poles, ahead or behind the position corresponding to uniform mean speed, two generators might be coupled together in parallel at the instant when the relative positions of the cranks of the two engines would be such that one generator would be the maximum distance in advance, and the other generator the maximum distance behind the position corresponding to uniform rotation. In this event the two generators might have a maximum relative spacing of 1-36 of the pitch angle between two consecutive poles. With this displacement Mr. Slichter states that the cross-current will be 10.9 per cent. of the full load current, provided the electrical characteristics of the alternators are such that the short-circuit current is 2½ times the full load current.

Commenting on this, Mr. Longwell says that alternators are actually built giving short-circuit currents as low as 2½ times full load current, while others are known to give as much as 6 times full load current on short-circuit, and all of these are supposed to come within the limits of standard representative practice. If, therefore, the amount of cross-current allowable is a very important matter, it does not seem reasonable that the manufacturers of alternators should put out an invariable specification to cover the requirements of generators which differ so widely. If the larger cross-current is allowable, it is asked why the engine builder should be burdened with the expense of making a fly-wheel which will give a displacement which will cause only 11 per cent. cross-current. Or if, on the other hand, 11 per cent. cross-current is nearer the allowable limit, it is asked why the engine builder should be blamed when the generator builder furnishes machines that will give 31 per cent. cross-current with the specified displacement.

The effect of cross-current is next discussed with respect to a synchronizing force tending to keep generators in step. The conclusion of Mr. Longwell is that while some synchronizing force is necessary to make paralleling at all possible, yet such force cannot pull two generators into phase and hold them there any more than the force of gravitation can pull an ordinary pendulum to the vertical position and hold it there. The synchronizing force tending to check the relative displacement between the generators exists only after the displacement has occurred, and when the generators are in phase the force is nil, and consequently there is nothing to hold them in phase. The conclusion is finally arrived at that the effect of the synchronizing force of the alternators is to *increase* the irregularity of the regular speed of the engine, instead of to *diminish* it. Mr. Longwell states that on first consideration this proposition seems absurd, but nevertheless it is capable of being demonstrated practically as well as mathematically. The portion of the paper in which this demonstration is given we reprint below in full.

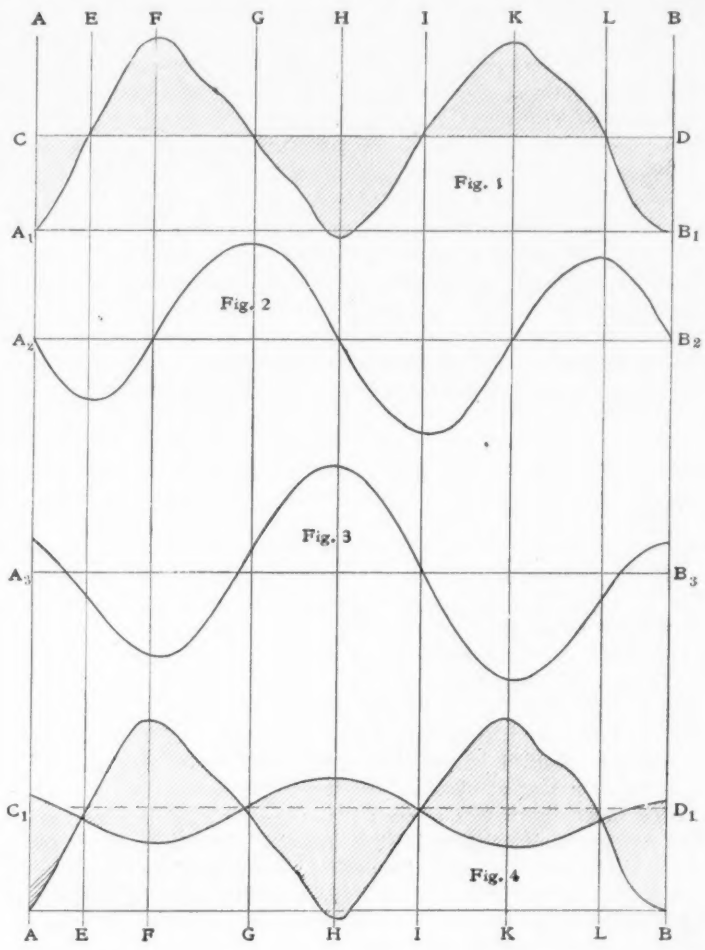
Mr. Longwell says that the matter first suggested itself to him some two years ago, in connection with the paralleling of some alternators in which the synchronizing power was rather large. The synchronizing force in an alternator can be varied by increasing or decreasing the field current and, in consequence, the voltage of the machine, and in these particular machines, which were of the two-phase type, the synchronizing force could also be greatly reduced by running the machines with only one phase connected in circuit.

Some difficulty was experienced with the paralleling at the start, and a rather extensive line of experimental work was undertaken in the endeavor to locate the trouble and to overcome it. Having a tank load available, these experiments could be carried out independent of the demands of the regular lighting service, and consequently the action observed of the machines over any desired range of load and voltage. It was found that when the generators were run in single phase they would parallel very satisfactorily, but when the second phase was cut in the cross-current would increase, and quite serious transfers of energy would take place between the machines. At that time it was authoritatively denied by electrical engineers of high standing that any two-phase machine would parallel more readily on one phase than on both; now, however, the fact is freely admitted.

It was also determined beyond question that by lowering the voltage to 80 per cent. of the normal—or, in other words, decreasing the synchronizing force 20 per cent.—the action of the machines in parallel was not open to criticism, even when running with both phases connected up.

The repetition of these experiments a sufficient number of times to determine that the observed phenomena were not accidents, but were in accordance with some fixed law, made it quite apparent that at least over the range covered by the experiments, the difficulties in paralleling increased with the synchronizing force of the generators.

Irrespective of whether a correction of the trouble could be effected by decreasing the sensitiveness of the governor, or improving the turning moment of the engine, or doing both simultaneously, the indisputable fact remains that with the original engine performance a variation of 20 per cent. in the synchronizing power made the difference between success and failure in operating the generators in parallel, and this seems to indicate the utter fallacy of specifying the same characteristics in the engine for alternators in which the synchronizing force may differ by 200, or even 300, per cent.



FIGS. 1, 2, 3 AND 4.—PARALLELING OF ALTERNATORS.

The fact that the synchronizing force does, under all ordinary conditions, increase the angular variation in the engine may be shown theoretically in a general way without recourse to any abstruse mathematics.

Fig. 1 represents a typical diagram of crank forces in a single-crank double-acting engine. $A_1 B_1$ represents the path of the crankpin for one revolution, and the ordinates of the curve represent to some chosen scale the tangential pressure on the crankpin at the corresponding point in the revolution; the area included between the

curve and the base line A_1 B_1 represents the work per revolution in foot pounds.

A_1 $C = B_1$ D represents the mean resistance of a uniform load reduced to the radius of the crank, and neglecting friction, the area of the parallelogram A_1 C B_1 D also represents the work per revolution in foot pounds.

The shaded portions of the area included between the lines C D and the curve, if above the line C D, represent in length the portion of the revolution in which energy is being stored up in the fly-wheel and in area, the amount of this energy in foot pounds. In like manner the shaded areas below the line C D represent the portion of the revolution in which the stored energy is being given up by the fly-wheel, and the amount of this energy.

While the crank is passing from E to G the fly-wheel is absorbing energy and its velocity is increasing. Consequently, at G, after having taken up the last foot pound of available energy, the velocity will have reached a maximum, and will then begin to decrease from G to I, while the wheel is giving up energy, becoming a minimum at I; similarly other maximum and minimum points will be found at L and E.

By mechanical integration of the curve in Fig. 1 referred to, the base line C D, we obtain a second curve, that of Fig. 2. The ordinates of this curve measured from the base line A_2 B_2, representing uniform mean velocity, indicate the velocity of the crankpin above and below the mean velocity. The scale of these ordinates depends on the mass and radius of the fly-wheel.

Referring to the velocity curve, Fig. 2, it will be noted that the velocity is less than mean from A to F, and consequently at the end of this period, at the point F, the crankpin will be at a maximum distance behind the position corresponding to uniform angular speed. From F to H the velocity is above the mean, and consequently at the point H the crankpin will be at a maximum distance ahead of the position corresponding to uniform angular speed, and so on.

Integrating the velocity curve referred to the base line A_2 B_2, we therefore obtain a third curve, Fig. 3, the ordinates of which referred to a base line A_3 B_3, drawn midway between the highest and lowest points in the curve, represent the departure at any point in the revolution from the position corresponding to absolutely uniform angular speed.

It will be noted that the displacement curve, Fig. 3, and the curve of crankpin forces, Fig. 1, have a general resemblance in shape, in that each has the same number of nodes; but the nodes of one curve are directly opposite to those of the other. In other words, when the crankpin effort is above the mean and the surplus energy is *accelerating* the rotating masses, these masses are always *behind* the position corresponding to uniform angular speed; and when the crankpin effort is below the mean and the rotating masses are being *retarded*, these masses are always in *advance* of the position corresponding to uniform angular speed.

Next consider the effect of the synchronizing force of the generators. For simplicity it will be assumed that the engine-driven alternator is coupled in parallel with a number of turbine-driven alternators running at absolutely uniform speed, and that the total mass of these alternators is such that the synchronizing force can effect no appreciable change in their velocity. Whenever the steam-driven alternator is behind the position corresponding to uniform angular speed, the synchronizing force tends to accelerate the rotating masses; and wherever it is in advance of the position corresponding to uniform angular speed, the synchronizing force tends to retard the rotating masses. The intensity of these accelerating and retarding forces is represented at any point in the revolution by the ordinates of the displacement curve, the scale being portional to the synchronizing power of the generator. It will therefore be readily seen that *the synchronizing force acts in unison with the crankpin force.* During the period of the revolution in which there is a surplus of crankpin effort this surplus is augmented by the synchronizing force, and during the period in which there is a deficiency of crank effort, this deficiency is further augmented by the synchronizing force.

This may be shown graphically in Fig. 4, in which the crank effort curve is reproduced from Fig. 1, and the line of load resistance, instead of being represented by a straight line, is represented by a curve of the same general form as the displacement curve, indicating the change in load during the revolution, due to the synchronizing force. The shaded areas in this diagram illustrate the unbalanced forces resulting from the combination of the crankpin and synchronizing efforts. It will be noted that the unbalanced forces are very much greater than those due to crankpin effort alone, and as these unbalanced forces are the cause of the departure from the position corresponding to uniform angular speed, it is evident that whatever increases these unbalanced forces will increase the variation from uniform speed.

The calculation of the exact amount by which the synchronizing force increases the displacement is a tedious and somewhat involved mathematical process. It is necessary to compute the displacement from the force diagram, and after finding the value for the synchronizing force, to construct a new diagram combining the two forces, and compute the displacement corresponding to the new force diagram. This process must be repeated until no appreciable increase in the displacement curve is found.

The effect of the synchronizing force between the alternators is analogous to that of a spring capable of both extension and compression, and, considered apart from all other forces, will produce an oscillation of the rotating masses, the period of which oscillation depends on the intensity of the synchronizing force and the magnitude of the masses.

The period of this oscillation has a very important bearing on the amount the angular displacement is augmented by the synchronizing force. With a period which corresponds with the time of one revolution of the engine the angular displacement seems to be increased indefinitely. As this natural period of oscillation is increased or decreased from the critical period, the effect of the synchronizing force on the displacement seems to decrease.

Of course, if the synchronizing force were infinite we would have the same effect as if the generators were solidly linked together, and the actual displacement would be the mean of the individual displacements of the several units in parallel, and would be less than that of any unit running independently. There is also, perhaps, a period of oscillation between the critical period and an infinitely short period, which would not increase the displacement, and doubtless as the period decreases from the point the displacement would decrease. At the outset, however, the general proposition was limited to *practical cases,* and these are not practical. The rotating masses must of necessity be of such magnitude that it is impracticable to have a synchronizing force sufficiently large to cause oscillations having a period much, if any, less than the time of one revolution.

Mr. Longwell, in conclusion, said he would feel happy if he has succeeded in indicating a new line of investigation in connection with this troublesome problem, and doubly happy if he shall succeed, even in the smallest degree, in making it plain to the electrical fraternity that the electrical and dynamic features in the case are so inter-related that real knowledge can come only when the electrical engineer and the mechanical engineer drop all petty differences and co-operate with each other in the most frank and hearty manner.

As long as one is expected to blindly and unquestioningly follow the dictates of the other, successful paralleling will be by accident rather than design. The whole matter is one of compromise. Let it be freely admitted that the irregularities in the action of the engine do set up electrical disturbances. The reciprocating engine will always have an irregularity in angular speed, and consequently electrical disturbances are inevitable. The engine builder can control the amount of this irregularity to a certain extent, but he is barred by constructional and commercial limits from reaching absolute perfection.

On the other hand, the electrical disturbances react on the engine, augmenting the inherent irregularities in the latter, and the intensity of this reaction is, within certain limits, under the control of the electrical engineer. It is therefore only when the engine builder and the electrical engineer each recognizes the limits beyond which the other cannot go, and each endeavors honestly to make the task of the other as easy as possible, with due regard to the commercial excellence of the direct-connected unit as a whole, that we may hope that the parallel operation of direct-connected alternators will cease to be a subject for discussion.

One Martinique Tragedy

A cable dispatch from Paris says: Young Mme. Martinot, married a year ago, unable to receive news from her husband, who went to Martinique a few weeks ago to install a new electric tram line, fatally shot herself and her baby a few days ago.

St. Louis Municipal Electric Power Plant.

The electric power plant operated in connection with the St. Louis municipal water works, though but a small plant, it is of considerable interest because of the sumptuous manner in which it has been equipped, and also on account of the rather unusual method adopted for driving one of the alternators, which is direct-connected to an impulse water-wheel receiving water from the delivery side of the main pumping engines. This somewhat roundabout way of

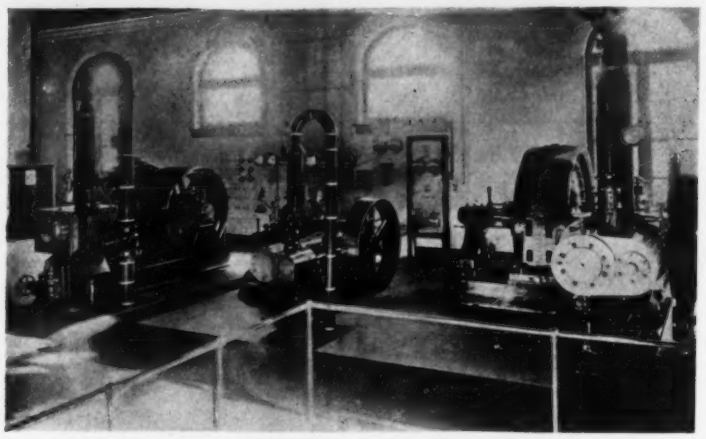


FIG. I.—ENGINE ROOM, ST. LOUIS MUNICIPAL PLANT.

transmitting power from the engine to the dynamo has proved perfectly satisfactory under the conditions existing in this plant.

The plant furnishes current for the municipal railway, extending from the Baden pumping station to the Chain of Rocks, and for lighting the several buildings belonging to the water department and located at various points in a distance of about five miles along the Missouri River. Although the electric plant is, in a way, but an adjunct of the waterworks pumping plant, it is handsomely installed and excellently maintained, and, for its size, is a model power station.

The electrical equipment consists of a 100-kw railway generator and two alternators, one of 100 kw and one of 20 kw, with exciters, switchboard, transformers, etc., all furnished by the Westinghouse Company. The direct-current machine operates at 575 volts and 275 r. p. m., and is direct-connected to a Straight Line engine. This generator has run continuously at full load for 24 hours, with a temperature rise above the surrounding atmosphere of considerably less

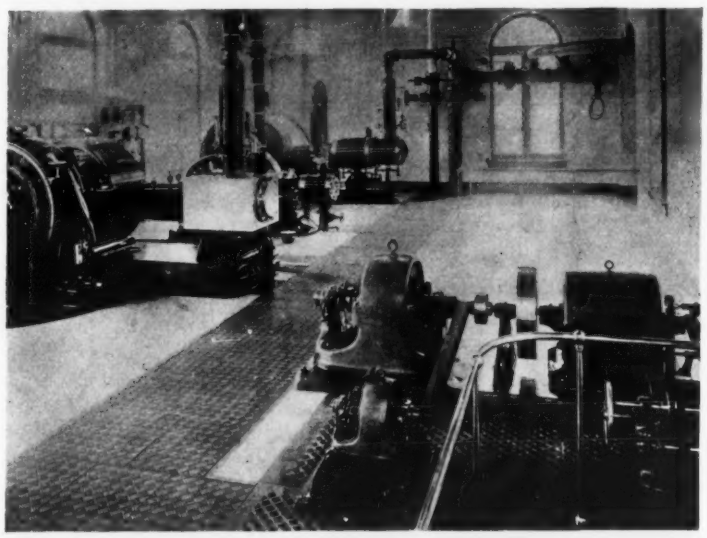


FIG. 2.—ENGINE ROOM, ST. LOUIS MUNICIPAL PLANT.

than 40° C. In the same test the economy of the engine was 22 lbs. of steam per hp-hour.

The large alternator, which is used during the heavy lighting load in the evening, is of the revolving-field, single-phase, engine-type, running at 277 r. p. m., 1,150 volts and 60 cycles. In a 24-hour full load test it has shown a maximum temperature rise much below 40° C. It is direct-connected to a tandem, compound Ideal engine. The exciter for this machine is of 3.75-kw capacity, and is a multipolar, compound-wound, belted generator, running at 125 volts and 1,600 r. p. m.

The 20-kw alternator, which is also used for lighting, operates during the entire day and that part of the night in which the load is light. It is direct connected to a Pelton impulse water-wheel supplied from the water mains and running at 1,200 r. p. m. This method of transmitting power through the engine and pump to the dynamo may at first thought seem questionable, because of the many transformations and consequent loss of energy involved; but when it is remembered that the efficiency of a large pumping engine is high while that of so small a steam engine as 20 kw would be low, the reason for the choice of this method is apparent. Indeed, tests have shown that the Pelton water-wheel is so efficient that this generator is operated on a total steam consumption of about 30 lbs. per electrical hp-hour, which is probably much less than could be obtained with so small a unit by direct connection to an engine. Of course, the principal advantage of the water-wheel drive is in the matter of first cost, a water-wheel costing much less to install and requiring less care than an independent steam engine of the same capacity. The exciter is a 0.56-kw, compound-wound multipolar machine, running at 1,400 r. p. m. and 125 volts.

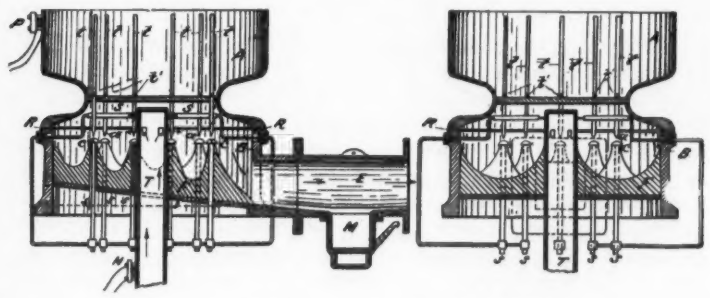
Recent Developments in Electrochemistry.

BY CLINTON PAUL TOWNSEND.

Reference has recently been made in these columns to the electrical methods developed by M. Paul Bary, of Paris, for the distillation of various metals, either for the production of powders or of oxidized products. In so far as these methods have depended upon the principle of volatilization of molten metal by a sufficient current, they are merely modifications of what is well known in the art. M. Bary's most recent patent, however, is distinctly novel in character, depending for the volatilization upon the spark, or perhaps more accurately the arc, which is formed when a stream of molten metal carrying a current is momentarily interrupted. Under the sudden increase of resistance metal is vaporized, and if the operation is carried out in a closed vessel, and in a current either of inert or oxidizing gas, the products are readily collected.

In all forms of apparatus described, molten lead or tin flows in a thin stream from an upper to a lower vessel, and conducts the current between them. This falling stream is momentarily interrupted, either by a mechanically operated valve controlling the outflow, by a rotating skeleton wheel whose spokes break the column, or by the current itself as hereafter described.

Full utilization of the current requires a more rapid interruption than can be effected by mechanical devices, and M. Bary describes as his preferred form the construction herewith figured. The molten metal flows from the upper chamber *A* to the hearth *B* through a series of nozles *t*, perforated at *t*¹ and extending above the surface of the pool. Each stream impinges upon a metallic contact *c* in the circuit *s*, and the volatilized products, together with the excess of liquid metal, pass through the tube *E*, the former to the collecting



APPARATUS FOR DISTILLATION OF METALS.

chambers and the latter to the trap *M*. A current of inert or oxidizing gas flows through the pipe *T* and the lower chamber *B*. This chamber is fitted with a refractory bed *F* and with resistances *S*, the function of the latter being to keep the metal in both chambers in molten condition. Electrical connections are shown at *P* and *N*, the circuit being completed through the stream issuing from the orifices *a* of the tubes *t*, and otherwise broken by the line of insulation *R*.

The necessary interruption of the flowing stream in this construc-

tion depends upon the experimental fact that a film of metal traversed by a current of sufficient density is contracted and broken, to be at once restored, the interruptions occurring at the rate of several hundred per second. In curious parallelism to this is the observation of Bredig and Haber that a heavy current passing through an electrolyte to a lead wire cathode (in other words, a Wehnelt interrupter) disintegrates the cathode metal, filling the solution with clouds of its dust.

TREATMENT OF ZINC ORES.

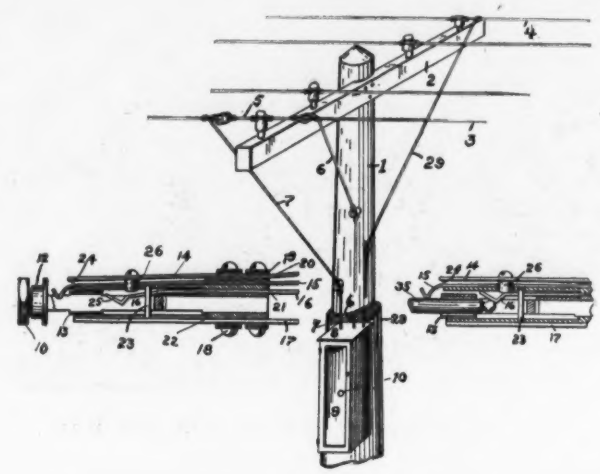
A patent to Mr. Samuel S. Sadtler, of Philadelphia, covers the process of treating zinc ores which formed the subject of one of the papers at the recent meeting of the American Electrochemical Society, and was reported in that connection. Briefly, zinc sulphide, subjected to alkaline hypochlorite solutions yields free sulphur and sodium zincate; the solution is electrolyzed, zinc being deposited and the solvent regenerated. Now the method of Burghardt consists in reacting with caustic solutions upon oxidized zinc ores to form the zincate, followed by electrolytic deposition of the zinc and recovery of the caustic. The invention is, therefore, in effect the substitution for metallurgical oxidation, of oxidation by hypochlorites; and to determine its value the speed of this reaction must be known. This is the one essential point, but with reference to it the specification is silent.

REDUCTION OF NITRO AND AZO-COMPOUNDS.

Few reactions have been more fully studied in their electrochemical relations than the reduction of nitro-benzene to aniline. The influence of the solvent and the current density have been clear, and the later work has recognized also the further influence, at first unsuspected, of the nature of the cathode. Dr. Max Buchner, of Mannheim, Germany, bases three patents upon the selection of a suitable cathode material for the reductions, or what amounts to the same thing, the introduction into the cathode solution of appropriate metals or metallic salts. A series of eight examples is given, detailing for as many compounds the best conditions for the reduction. For the nitro-compounds it is found that a cathode of tin exerts the most favorable influence, and permits the use of current densities approximating 18 amperes per square decimeter; the reduction occurs without sensible evolution of hydrogen, and the metal of the cathode passes continuously from the molecular to the ionic state and *vice versa*, being continuously taken up by the nitro-compounds and again thrown out by the current. For the reduction of azo-compounds powdered tin is preferably suspended in the catholyte, and the current density reduced to 3 to 4 amperes per square decimeter, or a cathode covered with tin sponge may be used. In either case the temperature is maintained at about 60° C. Copper also, it is found, may serve as a cathode for the reduction of nitro-compounds, and is preferably added as cuprous chlorid to the catholyte and separated out by the current.

New Telephone Patents.

The solitary telephone patent of the issue of May 20 is hardly calculated to work a revolution in the art or to make a fortune for the inventor, Mr. Evan Shelby, of West Lafayette, Ind. The invention is described as a telephone or telegraph system, and consists of a special form of jack mounted on a box set on a pole of a telephone or telegraph line, and so connected to one wire of the circuit that the insertion of a plug connected to a portable set will cause that set to be connected to the central office and the line beyond the test-pole to be cut off. A battery is connected so that the insertion of the plug puts the battery momentarily to line to throw the drop or signal at the exchange. The inventor claims that one of the important uses of the system is to provide telephones for police-calls or patrol-boxes, fire-alarms, or any similar purpose. For illustration, this system of police calls can be introduced by merely placing jacks, inclosed in suitable boxes on the telephone poles, at various points in a town or city, and connecting the boxes with the regular telephone wires above. This avoids the necessity of an independent telephone system for such purposes and does not materially interfere with the use of the regular lines. In the drawings, Fig. 1 shows the method of mounting the test-box on the pole and of wiring the circuits to the jack and battery, wire 3 being broken at 5 and led by wires 6 and 7 to the jack, and wire 4 being tapped by wire 29 to the battery. Figs. 2 and 3 are sections of the jack adapted to be fastened in the door of the box by the ring-bolt and nut, 12 and 10, so that the plug may be inserted and connection made with the jack without opening the box. Fig. 4 shows a diagram of the connections. The lead 7 from line 3 is connected to line-spring 15 of the jack, and lead 6 is connected to strip 17, in which is imbedded a contact pin, 23, on which spring 15 normally rests, so that in the idle condition of the jack the line 3 is continuous through 7, 15, 23, 17 and 6. The spring 16 is connected to one pole of the battery, the other pole being connected to line-wire



FIGS. 1, 2, AND 3.—SHELBY TELEPHONE AND TELEGRAPH SYSTEM.

4. Spring 16 is also connected to strip 14 on the top of the jack by wire 30. When the plug is inserted line-spring 15 is first lifted from pin 23 and then pushed into contact with contact-plate 24, thus breaking the continuity of line 3 and putting the battery across the circuit, so that the act of inserting the plug cuts off the line beyond the pole and puts signalling current on the line toward the central office. When the plug reaches spring 16 and pushes it up, strip 14 is raised out of contact with spring 15 by the upward pressure of 16 on the insulating stud 26, as shown in Fig. 3. The battery is then cut-out and the portable set is in circuit. The arrangement is neat and effective and might conceivably find application for economical police

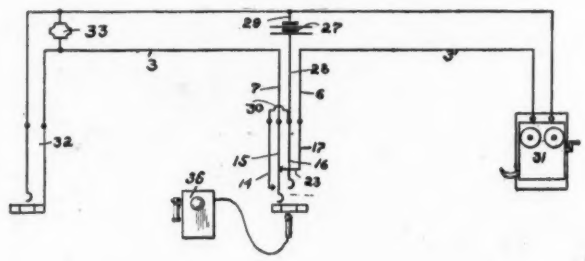


FIG. 4.—DIAGRAM OF CONNECTIONS.

patrol systems in comparatively quiet places where telephone users would not rage too furiously at their telephone connections being occasionally interrupted in the interests of the public safety. Even if special circuits were run, the system provides a cheap method of equipping patrol or call-boxes; it has the defect, however, of giving no indication of whether the line cut in on is in use or not.

Independent Telephone Convention.

It has been arranged that the Independent Telephone Association of the United States will hold its annual meeting in Philadelphia, June 24, 25 and 26. The headquarters have not been selected, but a very large attendance is expected. The committee on programme and arrangements is: S. P. Sheerin, Indianapolis, Ind.; S. E. Wayland, Philadelphia, and E. D. Fisher, Grand Rapids, Mich. The Ohio convention usually held in June, will be put off until later.

American Export Trade Figures.

A good deal of encouragement to the manufacturing interests of the country is found in the detailed statement of commerce for the month of April and the ten months ending with April, just issued by the Treasury Bureau of Statistics. It shows that manufacturers' materials formed one-half of the importations during the month of April, and in the ten months formed over 16 per cent. of the total; while the exports of manufacturers in the month of April formed 36.54 per cent. of the total exports, against 29.15 per cent. in April, 1901, and for the ten months ending with April, 1902, they formed 28.55 per cent. of the total exports, as compared with 27.40 per cent. in the corresponding months of the preceding fiscal year. The total value of manufacturers' materials imported in the ten months ending with April, this year, is $348,657,061, as against $280,801,407 in the corresponding months of last year, an increase of $67,855,654, or 24 per cent. Exports of manufactures, it will be observed, are nearly overtaking those of last year, the gain in the month of April alone being four and a half million dollars over April, 1901, while for the ten months the total value of manufactures exported falls but $5,486,814 below that for the corresponding months of last year. Manufactures formed considerably more than one-third of the exports in the month of April, having formed 36.54 per cent. of the total, against 29.05 per cent. in April, 1901; while for the ten months the percentage which manufactures form of the total exports is higher than in any preceding year except 1900.

Road Test of Edison Storage Battery.

During the past week, several important tests have been made at Glen Ridge, N. J., with the Edison storage battery mounted on a light runabout. A standard equipment of cells was placed on the vehicle which had its ordinary motive power of one motor. The test was a very severe one, 12 per cent. grades being climbed, while the roads were the roughest to be found in the Orange Mountain region. The vehicle made, all told, 62 miles before coming in, and when the battery was tested it had still left in it a capacity of several miles. It is understood that there were 21 cells, weighing 332 pounds.

Several days later the vehicle, still equipped with the same battery, made another run over fairly level and smooth roads, on which it covered 85 miles on the single charge. The battery came back in excellent shape, ready for recharge, and perfectly ready to run out again.

Such results are regarded as highly satisfactory, being merely preliminary, and leaving no doubt in the minds of those working on the adaptation of the battery to automobile work, that much better showing even will be made at an early date. Mr. Edison is naturally very much gratified at this prompt confirmation of his statements in regard to what the battery will do.

CURRENT NEWS AND NOTES.

CUBAN TELEGRAPH SYSTEM.—During the period of occupation of Cuba by the United States, 5,000 miles of telegraph lines were built by the United States Signal Corps. The system was turned over to the Cuban government on May 20, when the authority of the United States was transferred to the representatives of the new Cuban republic.

HIGH-SPEED RAILWAY.—A Norfolk, Va., newspaper refers to an electric car on exhibition in that city, designed to run at the low speed of 400 miles an hour. The inventor, it is stated, declares that "the speed at which the car will travel is restricted only to the speed at which electricity travels on a telegraph line, making allowance for a certain amount of friction." Why further Zossen trials now?

WESTINGHOUSE ELECTRIC CLUB.—The employees of the Westinghouse Electric Manufacturing Company, at the East Pittsburg plant, have organized an electric club for instruction in applied electricity, drawing and mechanical engineering. Classes will be formed and lectures given. The club has 175 members. It is stated that officials and heads of departments, together with skilled mechanics, will have charge of the instruction.

THE LOST "GRAPPLER."—The West India and Panama Cable Company announces that it has chartered and properly fitted up the steamer "Newington," which will leave London in about three weeks, to replace the cable repair steamer "Grappler," which, with her entire crew, was lost as a result of the first of the recent outbreaks of Mont. Pelée. The "Newington" will take the place of the "Grappler" until a new steamer can be built. Over a hundred miles of cable was lost aboard the "Grappler." Four cable sections are now interrupted.

THE AMERICAN ELECTROCHEMICAL SOCIETY will hold its second general meeting at Niagara Falls, N. Y., beginning Monday, September 15th, and extending to the 17th, or possibly to the 18th. The local committee will provide interesting excursions and exhibitions of the local electrochemical industries, which will be an important feature of the meeting. A number of important papers are already promised, and the prospects are that the meeting will be even more successful than the inaugural meeting at Philadelphia. Entertainment will be provided for ladies.

JOHN FRITZ MEDAL.—An organization of members of the four great national engineering societies has been effected to found a gold medal in honor of the eightieth birthday of John Fritz, the celebrated American metallurgist. The bodies represented are the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers, and the American Institute of Electrical Engineers, and the committee formed comprises the following: S. T. Wellman, chairman; C. Kirchhoff, secretary; John Thomson, treasurer; C. W. Hunt, F. R. Hutton, R. W. Pope, A. Swasey, J. M. Smith, E. E. Olcott, T. C. Martin, J. C. Kafer, H. G. Prout, E. G. Spilsbury, S. W. Baldwin, N. H. Heft, R. W. Hunt and O. Williams. The subscription to the fund is ten dollars, and it is expected to raise five or six thousand dollars. The founding of the medal will be celebrated in the Fall by a dinner, about November. Rules and regulations governing the award of the medal by a board of sixteen, drawn from the membership of the four societies, have been carefully drawn up and are printed in the circular issued by the committee announcing this movement. Every indication points to the great success of this plan of doing honor to one whose work has done so much for the advance of American industries based on the metallurgy of iron and steel.

SPANISH ELECTRIC RAILWAYS.—Mr. B. H. Ridgely, U. S. Consul at Malaga, Spain, says: As a matter of interest to American builders and projectors of electric railways in Europe, I would report that a meeting of the stockholders of the Orense and Vigo Railway Company will shortly be held, to discuss a plan for applying electrical traction not only to the line (82½ miles in length) from Vigo to Orense, but to all the various lines of the important province of Galicia. There is a large waterfall in the midst of these lines, and it is proposed to utilize this for producing power, beginning first on the line connecting the important seaport of Vigo with the large interior town of Orense. It may be said, incidentally, that there is a strong feeling in Spain in favor of the American system of electrical traction, as well as of American rolling stock, and if it should be decided to introduce electrical traction as widely as is proposed, it seems to me that Americans interested in such ventures would do well to look into the matter. While writing on this subject, it may be worth while to call attention to the city of Toulouse, in southern France. This is one of the largest towns of the French Republic, with a population of about 175,000. It has an extensive street railway system with many suburban lines, but the whole system is operated by animal traction. It is thus the only large city in France that has not adopted electrical traction, and a gentleman in discussing the matter with me recently expressed the opinion that it must soon follow the example of the others. Here, then, is another town that interested Americans would do well to watch. In closing this report, I may add that an American electrical engineer arrived at Malaga some months ago, and is now engaged in surveying a route for a proposed electrical suburban railway to connect this city with various neighboring towns and villages.

LIGHTING A TUNNEL.—The Erie Railroad tunnel at Jersey City is being equipped with electric lights, and it is expected that the system will be in operation within a week. There will be 150 lights, placed at intervals of 50 feet. They will be on a level with the locomotives, so that the engineers can have no trouble in seeing them.

A RUSSIAN CONCESSION.—A cable dispatch from St. Petersburg, of May 21, says: A concession for the establishment of an electric railroad from St. Petersburg to a suburb of the city was awarded to-day to M. A. Verner, of Pittsburg, Pa. Mr. Verner's friends regard the granting of this concession as an indication of favorable action with regard to a concession embracing the entire surface traction system of St. Petersburg.

LARGE TROLLEY PROJECT.—A double-track electric railway from the borders of Canada to the Gulf of Mexico will be a realization within the next few years, if the plans of a syndicate of the Mississippi Valley, with Judge John Porter, of Eldora, Iowa, at the head, shall be carried out. The railway, according to the present plans, will start near the Lake of the Woods, and will follow the Mississippi Valley to the Gulf. A meeting of the promoters, representing every State between Minnesota and the Gulf, will be held at Des Moines June 1, to perfect the organization.

MARCONI SEA STATION.—The schooner "Pleiades" sailed from Philadelphia on May 15, to take her permanent station 300 miles off the Cape Cod coast, as a wireless telegraph signal vessel. The schooner is equipped with the Marconi system and will lie directly in the track of vessels bound to and from Europe: She will report all vessels carrying Marconi equipment. Communication will also be maintained with two steel steamers, now being equipped with the same system, which will lie along the Atlantic coast line to the south, one being stationed near Cape Hatteras.

A UNIVERSITY COMMERCIAL COURSE.—The University of Birmingham, England, has instituted a Faculty of Commerce, which will begin its work on October 1, 1902. This will consist of a course of training suitable for men looking forward to business careers, and its object is the education, not of the rank and file, but of those who will ultimately guide the business activity of Great Britain. A three years' course, leading to the degree of Bachelor of Commerce, has been drawn up, and it comprises studies falling into four main categories: language and history, accounting, applied science and business technique, and commerce.

LORD KELVIN HOME.—English dispatches announce the safe return of Lord and Lady Kelvin. Interviewed in London by the correspondent of the New York *Journal,* Lord Kelvin said: "My sojourn there was really to all intents and purposes a private one. I learned much as to the immense strides in scientific processes accomplished by Americans, of which too little is heard here. As to the shipping combine, though people were talking about it over there, expressing great admiration of Morgan, I have heard more about it from the English papers than I did in New York. All my intercourse with friends in America showed that there existed a very real and sincere friendship on the part of the American people for Britain. Everything I saw strengthens this impression, and friendships are strong enough to outweigh any political troubles that may arise. There will, of course, be a very strong commercial competition between the two countries in the future, but I believe we shall gain as much by it as our American friends."

VOLCANOES AND MAGNETIC NEEDLES.—Superintendent Tittman, of the Coast Geodetic Survey, furnishes the following memorandum regarding the disturbance of magnetic needles by the second eruption of Mont Pelée: "One the morning of May 20, from 4:07 to 4:16 eastern time, or 5:03 to 5:12 St. Pierre local mean time, there occurred a slight disturbance of the magnetic needles at the Coast and Geodetic Survey Magnetic Observatory at Cheltenham, Md., beginning abruptly and reaching its maximum effect at 5:07. From 11:57 P. M., May 20, to 0:09 A. M., May 21, eastern time, or from 0:53 to 1:05 A. M., May 21, St. Pierre local mean time, a similar but somewhat larger disturbance occurred. According to the cable dispatch from Gov. L'Huerre, of the Island of Martinique, sent from Fort de France, and dated Tuesday, May 20, the second eruption of Mont Pelée apparently began about 5:15 A. M., closely coincident with the time of the first magnetic disturbance given above. Respecting the second magnetic disturbance, about midnight of the 20th, it is of interest to note that almost continuous earthquake shocks were felt at St. Augustine, Fla., from 9 to midnight, May 20."

WIRELESS TELEGRAPHY ON LAKE MICHIGAN.—A telegram from St. Joseph, Mich., of May 19, says: The Northwestern Wireless Telephone and Telegraph Company of Chicago purposes by July 1 to have a fully equipped wireless telegraph station at St. Joseph. If this proves successful other stations will be built at Holland, Muskegon and other east-shore points. The company are now establishing a station at Chicago, and will have one at Milwaukee, and intend to carry wireless apparatus on summer lake excursion boats. The company was incorporated in 1891 with $5,000,000 of stock. John S. Schwab, of Lafayette, Ind., is president; John P. Tansey, president of the Chicago Electric Engineering Company, is secretary; Prof. Henry Shoemaker and H. P. Davis, of Philadelphia, consulting electric engineers; Perry F. Miller, of Chicago, electric engineer and general manager of electrical construction. The system which is to be installed in Michigan has been given experimental tests at Lincoln Park, Chicago, and is not that of Marconi. A. B. Saliger, of the University of Washington, is the designer of the new system. The company estimates that it can transmit messages to and from vessels between Chicago and St. Joseph for 10 cents for a 10-word message, or 15 cents less than a land telegraph company who would carry messages.

LETTERS TO THE EDITORS.

The Telegraph of To-day.

To the Editors of Electrical World and Engineer:

SIRS: The letter from Mr. J. C. Barclay which appears in your issue of May 24 is apparently a reply to Prof. Pupin's recent criticism of the Western Union Telegraph Co. The suggestion at the beginning of the letter, "that the professor displays a wonderful lack of knowledge of the telegraph," is at least questionable. It is undoubtedly true that "practical experience" in telegraph business is a very valuable thing, but it is submitted that it is not necessary to be an operator or a superintendent of an office to become familiar with the business methods of the telegraph companies of the United States. It is certainly true that Prof. Pupin is entirely familiar with all the arguments set forth in the letter.

The real point at issue, as it seems to us, is the failure of the telegraph companies to recognize that there are two classes of messages which demand very different treatment, and are as distinct from each other as the telephone is from either. Another point is the failure of the companies to bring into use a system which not only meets the already existing demand, but stimulates and creates a much larger one.

No one questions that the Morse system of hand transmission and reception, as now in use, with all its perfection of detail, has come to stay, and fills an important demand, perhaps the most important; but this system should not be overburdened with business which is not suited to it, and which it transmits too well and too quickly and at too great a cost. In 1890 the president of the Western Union Telegraph Company testified before a committee of Congress that it cost that company an average of 22.4 cents per message transmitted. It will hardly be maintained that it will cost the company anything like this figure to transmit messages upon the plan outlined below. The quick transmission of stock quotations is evidently so important that the balance of attention has been given to this field instead of to the other.

It would undoubtedly be profitable to-day to establish a telegraph business such as that started in 1870 by Mr. Craig, or later by the American Rapid Telegraph Company, if it were not for the fear that the enterprise would meet with the same untimely end experienced by those companies which went out of business, not because there was any failure to find a demand for such a system. So far as I am aware no attempt has been made by the existing companies

to establish such a business as Mr. Craig contemplated, and certainly no successful attempt, which is of more importance.

Mr. Craig's idea was that each business house might be furnished with a typewriter perforator capable not only of making a typewritten copy to preserve in the office, but to prepare the letter in such shape that it is ready to transmit over the telegraph wire at the central office. All that the telegraph company is then required to do is to transmit this already prepared message over the wire and make sure that the received record agrees with that transmitted. The difficulties of doing this are often exaggerated, probably because of the small experience in the use of such systems. If a page and line receiver is used there is no difficulty in following with the eye the lines as fast as they are made, and a glance will reveal any important interruption of the line, for it is usually long enough to extend over several lines.

It is then proposed to send this letter just as received to the person addressed, and allow him to decide whether he will read it himself, have his stenographer make a copy of it, or have this work done at a typewriting office. In any case his letter is received in a very small fraction of the time required for a railroad train to carry it to its destination as is now the custom. This also gives an opportunity, for those who are willing to do so, to save the main expense of telegraphing, for the telegraph company is relieved of the business of typewriting, and does a strictly telegraph business. The telegraph company cannot then complain that the system is too slow as compared with the present one.

A very small number of trunk wires devoted to this purpose is all that will be required for some time to come, and the maintenance of them is insignificant when compared with that required to do the same business in the now accepted way. In fact, the part taken by the telegraph company is so small that it may not seem worth while to them to begin such an undertaking involving a great amount of pains and expense in developing it, and educating the people to its use.

The great influence which the controlling company can and does have over the progress of such plans is unquestioned, and is evidenced by a single example of which there are many. An independent company undertaking to do such a business would not be able to count upon obtaining any business from the Associated Press for example, its most important customer, for it is in the power of the existing company to refuse to lease any wires to them if they do any business with the new company. This would, of course, prevent them from dealing with the new company until such a company could offer the very extensive service all over the United States which the existing company affords.

The opinion as expressed in your editorial has my hearty indorsement.

TARRYTOWN, N. Y. ALBERT C. CREHORE.

To the Editors of Electrical World and Engineer:

Sirs.—Although Mr. Barclay's communication in your last issue, reviewing a criticism by Prof. Pupin on the slowness of the Western Union Telegraph Company in adopting new methods, is, as he himself states, "for the benefit of those unfamiliar with the practical workings of the telegraph," I, while confessing a limited knowledge of the subject, find warrant for intruding in the controversy, in view of Mr. Barclay's strongly expressed views on automatic telegraphy, which he assumes Dr. Pupin had in mind when he made his criticisms. At all events, it seems to be the *crux* of Mr. Barclay's action. As Mr. Barclay presumably writes in his official capacity as electrical engineer of the Western Union Company, and cites with pride its position in the march of events in the past, it is but fair to follow him through the different stages of progress from the beginning.

He says that when Prof. Morse built the first telegraph line—Washington to Baltimore—"he did not realize that he had invented the best, cheapest and quickest system of telegraphy that has been *introduced* up to the present time." I think Prof. Morse lived long enough afterward to be fairly well satisfied that under the management in control of the telegraphs at his death, no other system would be *introduced* in their day.

Mr. Barclay says that his company has kept pace with the demands of the people, and that foreign experts sent here to investigate admit that American telegraphy is years in advance of those of "most all other nations." So far as the writer is aware these admissions have never appeared in print, which leads to the suspicion that their private expression may have been in the nature of the tribute that polite insincerity frequently pays to bumptious conceit.

Mr. Barclay enumerates the steps of advance made by his company as follows: Abandonment of the Morse register for the sounder, multiplex systems, automatic repeaters, switchboards, copper line wires, insulation and conductivity, motor dynamos and storage batteries. Let us see about this formidable exhibit.

When operators began to read by sound it was forbidden by Western Union under pain of dismissal. Stearns duplex was opposed and derided by the Western Union Company for several years, while in operation on an opposition line—the Franklin. Edison's quadruplex was jeered at for a long time, although in successful operation on another opposition line—the Bankers and Brokers.

The synchronous multiplex system was at first denounced as a laboratory experiment, and when the owners built a line and put the system in operation between Boston and Providence, the Western Union claimed it would not work any further. This system, sending six messages simultaneously over a single wire, by Morse, has been in successful operation in England for 17 years. It is not used in this country.

Automatic repeaters and switchboards have been in use all over the world for nearly 40 years. Insulation as good or superior to the Western Union's has been used everywhere from the beginning of the telegraph. The American make of cheap glass is greatly inferior to the porcelain insulators used abroad. Copper wires were first used by the Bell Telephone Company, several years before the Western Union adopted them.

Motor-dynamos and storage batteries were articles of commerce, the latter at least being used abroad in advance of their use here. To go outside of this list, the Western Union ridiculed the telephone, and called it a toy for the amusement of women and children. They could have bought it for the price of a good automobile.

For years Germany and France have had underground wires as well as overhead lines over all important routes. England has had a magnificent underground cable containing 76 wires in operation between London and Birmingham for two years past, and is extending the service. The Pennsylvania Railroad and a telephone company are now considering underground communication between New York and Philadelphia. The Western Union was forced to bury its wires in the City of New York, but has shown no disposition to extend the work since, notwithstanding that during the sleet effects last winter it used the trains as a telegraphic medium for nearly a week.

Mr. Barclay's trial of the foreign automatic system referred to is small credit to the foresight and understanding of a telegraph engineer of his ability and prominence, and the selection of such a system as a representative of the automatic type looks very much as though the trial was for the purpose of exploiting a failure to support a fallacy. Every telegrapher knew from the first that such a system was impracticable, involving, as it does, photography and an apparatus so sensitive as to render it as useless for telegraphy over ordinary wires as a seismograph would be for tracing earthquakes when mounted on the Elevated Railway structure.

It requires for its operation less than one-half the voltage usually found vagrant on every wire within twenty miles of a trolley line, which would, of course, render its operation as erratic as a Thomson recorder would be on a circuit with leakage intakes varying from zero to 60 volts, not uncommon in these days. How any practical telegrapher could seriously entertain the idea of using a photographic record for commercial purposes must be a mystery to many besides myself; and the fact that this trial of a system, manifestly unfit, made two years ago, is now put forward as an evidence of the up-to-date alertness of the Western Union, does not seem to me a very strong point in the company's behalf.

Mr. Barclay uses the old argument that a Morse operator can send a message in the time that it is being perforated or prepared for transmission. No one has ever denied this, but he sidesteps the well-aimed fact that if there are fifty messages to be sent they can all be transmitted by automatic over one wire in the time of two messages by Morse. I do not care to go into the latest developments in automatic telegraphy, but it is now pretty generally understood that its opponents, to be fair, should shift their ground and abandon objections which belong to a past age. With the automatic system, affording at all times surplus carrying capacity, the average delay in transmission of telegrams would be very much reduced. To send the first

message within a minute, and delay the twentieth message an hour, makes an average delay of 30 minutes, which is rather below the average time that messages now hang on the operator's file.

Mr. Barclay points to telegraphic transactions between stock exchanges in 55 seconds as an example of the efficiency of the present service. Such deals were made 20 years ago in 15 seconds between Philadelphia and New York Exchanges over the Bankers and Merchants lines, and have been done between London and New York in 55 seconds, land lines and cables included; but the record of "Cresceus" is not a fair rating for "the old gray Dobbin."

Mr. Barclay objects to automatic on account of errors and the difficulty of correcting them. Seven years ago a Morse sounder was operated over an Atlantic cable, and the inventor, after many years of hard work and large expense, thought that his reward would be great; but the scope of his expectations was as nothing compared to the degree of his disappointment on being informed that though he could work a sounder at 40 words a minute, the company would not use it, on account of the *superior accuracy of automatic transmission and recording*. With the exception of those operated by the Western Union, all the Atlantic cables are equipped with automatic apparatus, and everybody knows that owing to coding and cipher, cable telegrams are the most difficult of all, and at the same time the most correct. A cipher cablegram from New York to Nagasaki, Japan, goes more correctly than a message in plain English from New York to Newark, New Jersey, and, generally, in quicker time.

The broker business between exchanges is the only branch of telegraphy that has "kept pace with the demands of the American people." If broker messages had to take their turn with those of the general public, the brokers would quickly see to it that the general average was raised. Before the ordinary citizen has a chance, the stock and other exchange wires, sporting news wires, Associated Press wires and newspaper private lines must all be provided, so that a summons to a death-bed must hang on the hooks for hours to make way for the stock transaction "in 55 seconds."

Mr. Barclay says that a number of automatic systems have been tried by his company, "but they have all been found lacking except for 'emergency' service." It would be interesting to know what constitutes an "emergency" in the Western Union. It cannot be the accumulation of business on the files for an hour or two, since the average time of the ordinary telegram throughout the country is more than two hours, against half an hour in the United Kingdom, where automatic is extensively used. Lying on the writer's desk is a telegram from a point 500 miles distant, which took over 25 hours in coming, and this in good weather. This would probably be considered an "emergency" warranting an automatic system.

If the Western Union was honest with the public it would put on each delivered telegram the time at which it was filed at its place of origin; but this it will never do, unless compelled by legislation, and the company is not disturbed on this point. Ohm's law does not apply to the "frank." Its motive force is not divisible by any resistance—on the part of the legislators. The telegraph company hoodwinks the public by putting the time of *arrival* on each message, thereby checking the movements of the much abused messenger boy, whose speed is, after all, as a winged son of Jupiter compared with the *modus operandi* of the telegram before it reaches the messenger's pocket.

The boast of nearly a million miles of wire and 66,000,000 messages in 1901 is a lamentable admission of mismanagement and stale engineering. With the speeds ranging from 10 to 60 words per minute, and 30 cents for ten words, it is no wonder that the number of messages fall below one per head per year. A modern conception of a telegraph plant for this country would be 100,000 miles of wires, automatic transmission yielding speeds of 100 to 2,000 words per minute, 20 words for 15 cents, and a business of 600,000,000 messages per year.

If Mr. Barclay will point out a single improvement in telegraphy originating on the outside that his company has not hampered, discouraged and discredited; or a single instance in which its encouragement has been extended for the development of an idea, whether for its own protection or the public benefit, the writer, who may not, and many who do not, "understand the workings of the telegraph" would be enlightened.

South Orange, N. J. Patrick B. Delany.

To the Editors of Electrical World and Engineer:

Sirs.—In responding to your request for comments upon charges made that the American telegraph systems are antiquated, I can only give my personal views as I have no client to defend. The subject must necessarily be considered with reference to existing conditions. The great demand by the public for telegraph facilities is between the hours of 8 A. M. and 5 P. M. A very large number of private wires are used by brokers and others between all principal cities, mainly between 10 A. M. and 3 P. M., New York time, during business days. The difference of time between London and New York and between New York, Chicago, Denver and San Francisco introduces some shifting backwards and forwards of heavy service at far west points to other hours of the day, but nearly all the United States commercial cities have to adopt their communications to New York City's business hours. So that outside of the hours mentioned the two great telegraph companies have a large surplusage of wires (including brokers' private wires), for which I believe the companies would be delighted to have profitable business. Sundays and holidays these wires are nearly all idle, and nearly all the expense of the maintenance and operation, including rents, taxes, management, etc., has to be borne by the traffic during business hours of business days.

The operation of wires at night is more expensive than during the day, as operators cannot stand so long hours of labor nor work to as good advantage, and expense for light is added. The hundreds of thousands of miles of wires used upon the single Morse system by private parties during the day can all be duplexed and quadruplexed nights and holidays by the telegraph companies leasing the wires, thus more than doubling the carrying capacities of such wires.

The telegraph companies for many years have had their offices open to receive and transmit at half rates the very class of messages you refer to in your editorial of the 24th inst., and they have actually differentiated between telegrams "demanding most rapid haste" and those "that may as well be delivered some hours later"; and I believe that the companies can prove, if they care to do so, that the latter class of telegrams and press service do not pay the expense of operation, and that, as before stated, the whole burden of expense rests upon the day traffic. This deferred traffic at half rates is naturally limited to very small proportions by reason of the splendid mail facilities between our principal cities, enjoyed by the business public, which alone has any use for such a convenience. Communications that will stand a few hours delay are more conveniently committed to the mails which not only insure sufficient dispatch but secrecy as well, not to mention the small cost of transmission.

I know of no automatic system that can be satisfactorily employed to move the great daily telegraph traffic of the country so expeditiously and economically as is done by the present Morse. I believe I have already made an accurate comparison of the systems in a discussion of the subject before the American Institute of Electrical Engineers, and printed in its *Transactions,* commencing page 130, Vol. 14, May 18, 1897. If customers' messages could be thrown into a hopper in New York and come out of a machine in Chicago at the rate of 500 or 1,000 words a minute, correctly printed upon blanks and ready for delivery, then the charge of old fogyism could be justly made against the proprietors of the telegraph in not adopting such a system and giving the public the advantage of lower rates. In fact, the proprietors would be foolish to persist in investing millions of dollars in pure copper wires when an automatic system would do so much better. But no automatic system of sufficient carrying capacity over one wire has yet been invented that obviates the expensive and slow preparation of the telegrams by special codification and manual manipulation at the sending end, and the special translation and manual transcription at the receiving end, with machinery more complicated than Morse, and at an expense for labor quite as great all told, as Morse, other things being equal; not to mention, as to each message, a delay to which the business public will never submit so far as the telegrams which "demand the most rapid haste" are concerned. At the same time I do not pretend to shut the gate in the face of improvements which are bound to come in all departments of industry, and there is very great room for them in the operation of the telegraph.

If these things are true, then the question arises, is there any method of transmitting telegrams that will enable the telegraph companies to handle the traffic, either cheaper or better, or both.

I attach hereto a record of a quadruplex circuit operated by the

Postal Telegraph-Cable Company between New York and Boston, 250 miles, for 21 days, 9 hours daily, showing an average of 1,485½ telegrams per day, or 41.26 per sender, per hour. On April 21st the highest record shows 1,699 telegrams in 9 hours—47.2 per sender per hour, or a total of 188.8 telegrams transmitted hourly over this circuit, all of which miscellaneous telegrams, including cablegrams, stock orders and quotations, were beautifully copied as received by sound, without an error, by the receiving operators at both ends of the circuit upon typewriters, and were instantly started to their destinations.

The business public is not finding fault with the present Morse system of transmission. Mr. Barclay accords to an automatic system its only value to meet emergencies, which I infer are incident to shortage of facilities by collapse of structure and wires during storms, which may be likened to the "half loaf being better than no bread." It will be found more satisfactory to erect trunk lines that cannot be disarranged nearly every day in the year. The telegraph has attained a public importance which demands between large cities a more substantial structure and wires of greater strength to be available to their full limit at all times. There should be two very stout short poles side by side, instead of one pole to support the cross-arms and wires, and when necessary other similar poles should be erected alongside to extend the system laterally. If private companies are to be allowed to continue the telegraph service of the country, they should be protected by the various State legislators, and be permitted to secure and maintain suitable rights-of-way, the same as railways. It is only after erecting such substantial lines that we could rely upon any automatic system which utilized a single wire for a large volume of traffic. A basket containing many eggs should not be liable to fall, and an automatic system must be produced which is as satisfactory and cheaper to operate than the Morse.

NEW YORK, N. Y. FRANCIS W. JONES.

Regular telegrams averaging 30 words, each transmitted on Postal Telegraph-Cable Company's quadruplex circuit between New York and Boston, from April 14 to May 7, 1902, 21 days, exclusive of Sundays, during hours from 8 A. M. to 5 P. M., 9 hours daily. The 19th of April a holiday in Boston. April 26th and 30th, weather very wet. May 3d and 6th, business dull on the circuit, and very light every day between 8 A. M. and 9 A. M.

April 14	1,585	April 22	1,578	April 30	1,549
" 15	1,410	" 23	1,562	May 1	1,557
" 16	1,576	" 24	1,475	" 2	1,425
" 17	1,471	" 25	1,493	" 3	1,343
" 18	1,443	" 26	1,550	" 5	1,476
" 19	1,012	" 28	1,565	" 6	1,414
" 21	1,699	" 29	1,507	" 7	1,505

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Heyland Induction Motor with Power Factor Equal to Unity.—BRESSLAUER.—A paper read before the Electrical Society of Vienna. He first describes, in a very simple and elementary way, the principles of the Heyland motor for three-phase currents, and remarks that he has found Heyland's theory fully confirmed by tests with an experimental motor. He points out the following advantages for the construction. It is no longer necessary to be as careful concerning the diminution of leakage and air gap; the number of slots which had to be made very high on account of leakage, can be essentially diminished; the motor becomes cheaper. He thinks, however, that Heyland's principle will be of still greater practical importance for the construction of generators. In the generator, however, a compound winding is to be added; this is the ideal method of compounding. In a foot note he states that Heyland has informed him that a 500-kw generator, designed according to this principle, has been tested and found to be very satisfactory; compounding was successful for a power factor equal to unity as well as for one equal to zero; he emphasizes this point because this has never before been accomplished in alternating current generators. Heyland generators can easily be operated in parallel. In the discussion which followed, some questions of Seidener brought out the fact that the no-load current in the experimental motor dropped from 15 amperes to 3 amperes, when the Heyland compensator was set into service; the current in the leads to the brushes was 250 amperes; the part of the stator winding which has to carry this current, is made a bar winding with a few turns; the other part of the stator winding is made of wire of smaller cross-section.—*Zeit. f. Elek.*, April 20.

REFERENCES.

Alternators with Commutator.—LATOUR.—An article, in which he discusses his alternators, which have been noticed repeatedly in the Digest. Their operation is explained by diagrams and simple mathematics. The article does not seem to contain any results which have not been noticed in former abstracts of the author's papers.—*L'Eclairage Elec.*, April 12.

Operation of Alternators in Parallel.—KLOENNE.—A long mathematical article, illustrated by diagrams. For the operation of alternators in parallel it is important that the relative variations in the instantaneous positions of the magnet poles relative to the corresponding armature windings in the different dynamos should be as small as possible. He calls these variations the "angular variations." He discusses at length mathematically the relation between these angular variations and the variations of speed, and gives graphical methods for determining these values. Numerical examples are added.—*Elek. Zeit.*, April 3.

Former-Winding.—DAVIES.—The first part of an article of a general nature on "formers and former-winding."—Lond. *Elec. Eng.*, May 9.

British Electric Machinery.—A well-illustrated description of the recently completed extensions of the Electric Construction Co.'s works, especially for the manufacture of large generating sets; also an illustrated description of the manufacture of continuous-current dynamos of the English Elec. Man. Co. In an editorial note it is said that the British "manufacturers have gone forward once again, and, we trust, will soon regain their leading position."—Lond. *Elec.*, May 9.

Steam Turbine Generator.—An illustrated description of the steam turbine generator of the Hartford Elec. Light Co. The generator is a 2,100-kw, 2,400-volt, two-phase machine.—*Elec. Rev.*, May 17.

LIGHTS AND LIGHTING.

Bremer Arc Lamp.—An illustrated description of some improvements of this lamp. As is well known, the two carbons are nearly vertical; they form a very small angle with each other; to light them, they are made to slide down in the direction of their own axis until they touch, and are then again removed from each other. But this is not a safe method, because the sides of the carbons which come together are often non-conducting, on account of the formation of a non-conducting sediment. The lower ends of the carbons, which are conductive, do not touch, in general. He therefore uses a special conducting plate, which is brought in contact with these lower ends. By an electromagnetic device, when the lamp is to be lighted the two carbons are brought nearer and the special conducting plate is at the same time brought into contact with the two ends of the carbons; current will then flow from the one carbon through that conducting plate to the other carbon; the electromagnet, which is in shunt with the carbons, then no longer receives sufficient current, and its action ceases, so that the carbons are removed from one another, and that especial conducting plate is also removed; the arc is thus formed. It is also recommended to combine with the lamp a small knocking device, which makes the carbons vibrate either continually or at intervals, and thus causes the non-conducting sediment which has been formed to fall off.—*Zeit. f. Beleucht.*, April 30.

REFERENCES.

Manufacture of Incandescent Lamps.—The first part of a detailed

illustrated description of the works of the Incandescent Elec. Lamp Co., at Brook Green, Hammersmith, which makes the Robertson lamp, and of the different steps of the manufacture.—Lond. *Elec. Rev.*, May 9.

Arc Lamp.—An illustrated description of "a new type of continuous-current arc lamp." It is a lamp containing two arcs enclosed in the same globe. Both arcs are controlled by the same mechanism.—Lond. *Elec. Rev.*, May 2.

POWER.

Large British Power Distribution Plant.—An article on the South Wales Electrical Power Distribution Co. A map is given showing the proposed area of supply. There will be several generating stations, among them the Pontypridd station, concerning which the following information is given: The completed station will have a total capacity of 75,000 hp, but only a fifth of the ultimate plant is to be put in at present. There are five steam engines, each of 3,000 hp, directly coupled to three-phase 12,000 generators, the frequency being 25. The alternators are to be run in parallel and excited by a separate direct-current generating set. The three core cables are to be paper insulateed, lead covered, and laid in earthenware troughs, run in with bitumen and covered with protecting tiles. This scheme is discussed in a long editorial. The fate of the enterprise will be decided by the question whether the company can afford to deliver power at a price that will make it worth while for the consumer to use it rather than generate it for himself. The only reason for anxiety is the relatively great capital expenditure on distributing mains. A high load factor is expected—very probably above 35 per cent. There is an extremely favorable "diversity factor" in the colliery and iron districts of Glamorganshire and Monmouthshire in respect to the consumption of power. Not only would this characteristic of the districts served insure a high average load factor, but the nature of many of the industries involve high load factors for their individual demands; as examples are cited the pumping and ventilating loads of collieries, the demands of electrochemical works, and the motor loads of such works as have to be intermittently carried on, day and night. The district covered by the scheme has an area of 1,034 square miles, with a population of over 1,000,000. For underground work in collieries, the induction motor will probably come into prominence.—Lond. *Elec.*, May 9.

Power Equipment of Grain Elevators.—An illustrated description of the electric power equipment of the three Great Northern grain elevators at West Superior, Wis. The power house contains at present a 410-kw and a 300-kw, 440-volt, 120 periods, three-phase alternator; extensions are to be made. In the three elevators there are installed on the whole sixty-two motors, ranging in size from 7.5 to 100 hp, and having an aggregate capacity of 2,750 hp. Many of the motors are designed for a 150 per cent. overload. The motors are all of the three-phase induction type, and operate on 400-volt circuits.—*West. Elec.*, May 3.

REFERENCE.

Colgate Power House.—Heitzmann and Currie.—A long and well-illustrated description of "S. K. C." apparatus at Colgate.—*Jour. of Elec.*, April.

TRACTION.

Polyphase Currents for Traction Work.—Galmozzi.—A paper in which he develops the formulas applicable to the case of a trolley line supplied with either two-phase or three-phase currents. He advocates the two-phase in preference to the three-phase system mainly on account of its greater economy, resulting from the fact that for a given frequency and a given amount of power delivered to the motors the current in the two trolley wires will be less, and that in the rails greater, in the two-phase than in a three-phase system, with a consequent saving in the Joulean heat losses, owing to the very much higher conductivity of the rails as compared with the trolley wires. He shows that under the conditions ruling in practice the additional lag due to the rails is not sufficient to cause serious inconvenience.—*Ass. Ing. El. Liege*, Bull., Anz, Sept., Oct., 1901, abstracted *Science Abstracts*, April 25.

Electric Traction.—Dawson.—An abstract of a paper read before the Tramways Committee at the Town Hall of Northampton. In 1896 the total capital invested in electric undertakings in Great Britain was about $30,000,000. Taking all the power distribution and traction schemes which are now either completed or under construction, the total amount of money invested reaches nearly $500,000,000. The total station capacity in kilowatts installed for lighting and traction purposes in the United Kingdom amounts to about 500,000 kw more. The total station capacity installed in London for all purposes is not much over 100,000 kw. New York has nearly 250,000 kw. There is a very large variation of the capitalization per mile of route. The total expenditure varies from a minimum of $45,000 per mile of route in the case of Leeds and Halifax, to $280,000 and $420,000, respectively, in the case of Blackburn and Glasgow. For estimating purposes it may be stated that the very best system, including power station, track, car, overhead work, feeders, etc., should be installed for from $75,000 to $100,000 per mile of route. A table gives the approximate cost of various parts of an electric traction system. A second table gives the increase of passengers carried in the case of some British electric railways; in the case of the Dover electric tramways the passengers have more than tripled within the last three years. He then refers to Berlin, with a population of 1,810,000; the tramways, which have now been converted entirely to electric traction, carried 188,000,000 passengers in 1899, as against 306,000,000 in 1901. The question of laying down a proper power station which will economically supply electricity for traction purposes is a very important one; and as the conditions that obtain in traction are entirely different from those which are met with in lighting work, a station eminently well designed for lighting purposes will generally be uneconomical for traction work. In a case in which an old lighting station exists and power is required for traction work, in nine cases out of ten there is but one thing to do, and that is to install an entirely new plant, with the possible exception of the boilers, for the traction work. This is the most economical method in the end. He also gives tables showing the influence of the load factor on the cost of generation, and prices paid by tramways for electric traction.—Lond *Eng'ing*, May 2.

The Double Trolley at Cincinnati.—An illustrated article. This system, which has the distinction of being the only double trolley in commercial use in the United States, was installed originally for the purpose of overcoming interference with the telephone system, and also with a view of eliminating trouble from electrolysis. Many complaints, however, have been made because of the failure of the latter precaution, and as the telephone system has been practically reconstructed, the reason for continuing the double trolley seems to have disappeared. The experience of the Cincinnati management shows that, in addition to the complications arising from a multiplicity of overhead wires, there are other disadvantages, mainly due to the difficulties experienced in keeping up the insulation at the curves and crossings. Many delays are also experienced in operating the cars, owing to the necessity of shifting the trolleys in rounding corners. There is also much "side wear" on the wire, which is said to be more than the ordinary wear of the single trolley, on account of the grinding action of the trolley-wheel. In order to keep this overhead system in condition ten emergency wagons are employed by the Cincinnati Traction Company, in addition to the regular repair crews. Attention is also called to the fact that where there is a grade the trolley wires are worn faster coming down the hill than those ascending, showing that the burning action of the current does not cause as rapid wear as the friction of the trolley rubbing on the wire coming down the hill. The management, however, states that the cost of motor repairs where the double trolley is used is noticeably less than on the single trolley system.—*St. R'y Jour., Int. Ed.*, May.

New Types of Overhead Material.—A description of three devices which have recently been perfected. The efficiency of an overhead trolley line depends very largely on the character of the crossings and section insulators, and much ingenuity has been shown in these devices to prevent the trolley-wheel from coming off, and to make them easy of installation. An uninsulated crossing is illustrated where the wires are electrically connected. Hinges and clamps are provided at the ends of the arms, which hold the wire firmly, no solder being used. The wire crosses over the insulator; the wheel in passing underneath runs on its flanges. Another figure shows an insulated crossing which is almost as simple. An insulating cylindrical cup, placed at the top of the crossing, separates the two wires, keeping them electrically apart, while the mechanical continuity of the overhead system is retained by the under portion of the device. A third figure shows a new section insulator which is particularly smooth underneath. This also secures the trolley wire by clamps. In all of these devices the clamps are adjustable, so as to accommodate all sizes of trolley wires ordinarily used, and the same crossing can be

used for both small and large wires at the same time without changing the parts.—*St. R'y Jour.*, May 3, and *Int. Ed.*, May.

Fayet-Chamonix Electric Railway.—An illustrated description of this railway, which has recently been opened in the French Alps; it is a branch line of the Paris, Lyons & Mediterranean Railway Co. The gauge is 3 ft. 3⅜ ins., the length 11.8 miles. The rack and pinion system could be dispensed with, the grades being mounted by adhesion. The sharpest curves are 490 ft. in radius; and of the two steepest gradients, one is 9 per cent. for 1.35 miles, and the other is 8 per cent. for 0.85 mile; the other gradients do not exceed 2 per cent. A third rail is used, with direct current at 550 volts. At the gradients a central brake-rail is fixed between the track rails, on which a special shoe-brake acts for limiting the down grade speed to 6.25 miles an hour. The contact rail rests on creosoted wooden blocks placed between every alternate sleeper. The electric bonds are of the usual plastic type. The contact rail is omitted over lengths of 16 ft. at those parts where the line runs over level crossings and in the vicinity of the covered platforms, turn-tables and switches, and the two ends are connected together by copper wire cables placed in a wooden conduit. The contact rail itself is also protected at several places with a wood covering. There are two generating stations, water-power being used. All the cars are motor cars; there are four or five to a train. They are all controlled from the front platform by a steering mechanism devised by Auvert, in which compressed air is used.

The good results obtained on this line, and the other experiments which the P., L. & M. R'y Co. are carrying out with electric traction, may lead it to introduce electric power on some of the new branch lines, among which would be that connecting Nice with the Italian frontier.—Lond. *Eng'ing*, May 2.

REFERENCES.

Cheatham Electric Railway Switch.—An illustrated description of this device, which is said to remove the necessity for bringing the car to a stop, to improve materially the running time, and to effect a considerable saving in the actual cost of power. In one test mentioned this switch gave satisfaction in service on one of the St. Louis Traction Company's lines at a point where 750 cars passed daily.—*St. R'y Jour.*, May 3, and *Int. Ed.*, May.

Syracuse.—A complete and profusely illustrated description of the street railway system of Syracuse, N. Y., which has recently been thoroughly recognized. The total capacity of the plant is now 3,000 rated hp, with a large allowable percentage of overload.—*St. R'y Jour.*, May 3, and *Int. Ed.*, May.

Traction Plant.—An illustrated article on the system of "firing the Metropolitan power plant" in New York, which is the largest railway power plant of the world. —*St. R'y Jour.*, May 3, and *Int. Ed.*, May.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

French Central Station.—H. H. B.—An illustrated article on the central station of Salon, a city in France of 13,000 inhabitants. The original station, erected in 1895, had three steam-driven single-phase alternators, the voltage being 2,500 and the frequency 100; transformers were distributed through the city, supplying a secondary network with a tension of 100 volts. Recently, when extensions became necessary, a small water-power of 50 to 55 hp in the city was bought, the hydraulic station charging a battery during the day and working in parallel with the steam station during the night; the alternators in the latter had therefore to be replaced by direct-current dynamos. The station now contains two steam-driven direct-current machines, each of 75 kw, and a third of 150 kw, the voltage being 250 volts. There is a storage battery of 170 cells, with a capacity of 1,000 amp.-hours, when discharged in 5 hours. A 30-kw booster is in use for charging. The hydraulic station contains a turbine-driven, 37.5-kw, 250-volt, direct-current dynamo. For distribution the three-wire system is used, with 250 volts between the outers. It is thought that the new arrangement will result in a considerable saving. During the summer months the hydraulic station and the battery will be sufficient to supply all the current.—*L'Ind. Elec.*, April 25.

Influence of Tariffs on Electricity Supply.—DICK.—An article in which he criticises sharply a recent article by Baker, and shows that the statistical methods used are wrong in principle. The only correct method of considering the influence of a tariff upon the load factor is to eliminate all other influence on the load factor. One should observe the results following the use of a given tariff in each individual station; one should notice whether the load factor shows an increasing, stationary, or diminishing tendency with the tariff in use, without regard to its absolute value compared with other stations. The load factor is not only the only consideration involved in the use of Wright's system; there is the equally important question of how to sell to each customer at the lowest possible price consistent with making a profit, or at least no loss. No method, except Wright's modification of Hopkinson's system, has ever thoroughly answered that question.—Lond. *Elec. Rev.*, April 25.

REFERENCE.

Determining the Size of a Battery.—IZART.—An illustrated article in which he describes a graphical method for calculating the size of a storage battery which has to supply a certain given irregular load. —*L'Ind. Elec.*, April 10.

WIRES, WIRING AND CONDUITS.

REFERENCES.

Gas Explosions in Electric Supply Conduits.—An article on a recent explosion and the resulting legal suit between the electric company and the gas company. The following rules of the Board of Trade concerning this exist in England: For all conduits, casings and street boxes used as receptacles for electric lines, reasonable means shall be taken to prevent accumulation of gas in them, and they shall be regularly inspected for the presence of gas.—Lond. *Elec. Rev.*, April 25.

Aluminum Transmission Lines.—An article giving short reports and notes on six transmission lines in which aluminum wire is used. —*Alum. World*, May.

ELECTRO-PHYSICS AND MAGNETISM

Magnetic Field Due to Electric Convection.—RIGHI.—A paper on this subject, which has become of special importance at present through Cremieu's experiments. Levi has investigated the problem of "an electromagnetic field produced by a charge in uniform rectilinear motion on the other side of an infinite conducting plane." The magnetic field is smaller on the other side of the plane than it would be were the plane not there. If the charge moves with a velocity equal to one-millionth of the velocity of light, parallel to an infinite copper plate 1 mm. thick, the magnetic field on the other side is only 8 per cent. of what it would be in the absence of the copper plate. Screens used in all experiments on electric convection must have a pronounced effect upon the magnetic field observed, if the moving charges are discontinuous. "If the electric field does not change, the effect of the screen is nil, and since the magnetic field of a current is not sensibly intercepted by a conducting screen, it follows that the electrons must move in the conductor in a practically continuous stream."—*Phys. Zeit.*, April 15; abstracted in Lond. *Elec.*, May 9.

Cremieu's Experiments.—POTTER AND POINCARE.—A reprint of a correspondence between these two physicists, the subject of which was Cremieu's experiments and an objection by Wilson. The correspondence is highly mathematical. They discuss the influence of the screen, and reach the agreement that its influence is zero.—*L'Eclairage Elec.*, April 26.

Ionic Theory of Self-Discharge.—STARK.—According to his theory of ionic shock, ionisation is usually produced by the impact of an existing positive or negative ion on neutral molecules. The force of the impact is due to the kinetic energy acquired by the ion in running down the slope of the potential, and the difference of potential necessary to secure an ionising shock is between 20 and 50 volts in the case of the negative electron, and 200 to 400 volts in the case of the positive ion. Regarding spontaneous discharge, he proves that it is not due to the emission of ions by the electrode. The fact that a very considerable difference of potential may be maintained between two electrodes placed very close together without producing a discharge, shows that there is some kind of constant force which prevents the ions from penetrating into the gas surrounding the metal. The author, therefore, attributes all self-discharge to what he has called, "frontier ionisation." The ions most concerned in that type of ionisation are the positive ions, and discharge begins to set in as soon as the difference of potential traversed by the positive ion in its mean free path is sufficient to make it produce an ionisation shock. —*Ann. d. Phys.*, No. 4; abstracted in Lond. *Elec.*, April 25.

Auto-Decoherers.—ROCHEFORT.—A discussion of decoherence. There are auto-decoherers and there are coherers which require tapping for decoherence. He shows that any auto-decoherer becomes a coherer which requires tapping for decoherence, if the pressure between the particles be relaxed. This is just the reverse of what has

been believed or what would be expected. The practical importance of self-righting coherers is greatly increased by their successful employment for wireless telephony. By a slight modification of the soft iron coherer, he has succeeded in using it both for wireless telegraphy and for telephony, according as to whether it was used as an ordinary coherer or as an auto-decoherer. The soft iron tube in question is derived from Tissot's tube. Such a tube, when "cohered" by a preliminary wave-train, shows a diminution of resistance which brings it exactly into the state of a highly sensitive auto-decoherer. This way of obtaining the required pressure is easier, more constant, and more certain than any mechanical means, which requires a too delicate manipulation.—*Comptes Rendus,* April 14; abstracted in Lond. *Elec.*, May 2.

REFERENCE.

Disruptive Discharges.—JOHNSON.—A brief article in which he gives some notes on the conditions of the formation of disruptive discharges.—*L'Eclairage Elec.*, March 15.

ELECTRO-CHEMISTRY AND BATTERIES.

Hoepfner Zinc Process.—A note stating that the production of zinc by Hoepfner's electrolytic process at Brunner Mond & Company's works, at Norwich, England, is now about 1,000 tons a year. "The process is admittedly a troublesome one in many ways, and but for the fact that the product is of a high degree of purity, and for this reason is in demand at an increased price, it is doubtful whether it would continue in existence." Practically the whole output is supplied to cartridge manufacturers who use it in preparing special copper-zinc alloys. The process is of some importance to the firm, as it helps in the recovery of chlorine from calcium chloride, which at present is a waste product in the ammonia soda process. "The process, however, will in all probability never have a wide application." —*The Eng. and Min. Jour.*, May 17.

Hargreaves-Bird Electrolytic Process for Producing Soda and Bleach.—WALKER.—A communication giving some information on this process, supplementary to his article, which was recently abstracted in the Digest. The diaphragm has a life of about 100 days, and must then be renewed. The carbon anodes require occasional renewal, but not so often as the diaphragms. The other parts of the cell are subject only to the usual wear and tear of ordinary machinery and plant. The only raw materials required in the process are brine, coal and lime, and there is no by-product or waste. Regarding processes with mercury cathodes, he claims that "none of them have been found to stand the test of practice as commercial propositions." —*Eng. and Min. Jour.*, May 17.

UNITS. MEASUREMENTS AND INSTRUMENTS.

Reichsanstalt.—The official report of the work of the German Reichsanstalt in 1901. Among the investigations of electrical interest are the following: Platinum resistances were standardized up to 500 degrees, and found to be correct within 0.15 degrees, whereas the error at the temperature of liquid air exceeds 2 degrees. Small standard resistances of 0.1, 0.01, 0.001 and 0.0001 ohm were tested after several months' rest, and were found to have remained constant to within a few millionths of their values. An important piece of work has been carried out with regard to the absolute temperature of a black radiating body; the laws according to which the total energy at a given wave length is proportional to the fourth power of the temperature, and the maximum energy proportional to the fifth power, lay the foundation of a new scale of temperature. The tests of the d'Arsonval galvanometer are nearly concluded. In the technical department a number of electrical measuring instruments, chiefly watt meters, were tested; also insulating materials and arc light carbons.—*Zeit. f. Instrumentenkunde,* April; abstracted in Lond. *Elec.*, May 9.

Ship's Compasses.—MELDAU.—A summary of the guiding principles underlying the construction of the modern mariner's compass. The only effective way of avoiding the disturbing swing of the compass needle is to increase the period of swing. The equality of mechanical moment about various horizontal axes is brought about by the subdivision of the originally single needle into several needles, mounted parallel to each other at various distances from the center of the rose. The moment of inertia of the latter is increased, after Kelvin's example, by placing the mass of the rose near the margin, the central portion consisting practically of silk threads only. Another successful method of providing the required steadiness is that of using a liquid in which the needle floats. The liquid generally used is a mixture of alcohol and water. The magnetic system has, of course, to be much stronger owing to the viscosity of the liquid. "The quadrantal deviation by masses of soft iron can only be obviated by means of needle induction." In the German navy soft iron masses are attached to the compass box itself.—*Phys. Zeit.*, April 15; abstracted in Lond. *Elec.*, May 9.

REFERENCES.

Analyzing Alternating Waves.—ARMAGNAT.—A long mathematical article illustrated by many diagrams, on the analysis of alternating waves and one determination of their harmonics, by means of a combination of the oscillograph with Pupin's method of resonnace. He replaces the electrometer in Pupin's experiments by an oscillograph. Numerous arrangements are described for special purposes. —*L'Eclairage Elec.*, March 15.

Analyzing Wave Curves.—HOSPITALIER.—An article illustrated by diagrams, on the application of the ondograph for the decomposition of complex electric wave into its harmonics.—*L'Ind. Elec.*, April 10.

Oscillographs.—BLONDEL.—The first parts of a well illustrated description of new oscillographs for plotting periodic curves of alternating currents.—*L'Eclairage Elec.*, April 12, May 3.

Measuring.—ARMAGNAT.—An article giving brief illustrated descriptions of several apparatus for measuring currents. Carter's device for the photometric study of arc lamps, Nisbett's speed indicator, Rieter's electromagnetic brake, and Morgan's transmission dynamometer.—*L'Eclairage Elec.*, April 26.

Weston Voltmeters.—A. S.—An illustrated description of the well-known modern Weston voltmeters of precision for industrial laboratories.—*L'Ind. Elec.*, April 10.

TELEGRAPHY. TELEPHONY AND SIGNALS.

Cable Relay.—BROWN.—An abstract of a paper read before the (Brit.) Inst. Elec. Eng. He describes his cable relay, which is no longer in an experimental stage, but is in everyday use on some of the lines of the largest cable companies, notably those of the Eastern Tel. Co., their system at Gibralter having been the first to be fitted up for "automatically translating" cable messages between Porthcurnow, in England, and Alexandria, in Egypt. The adjoining diagram shows the arrangement of the relay. The cable and the

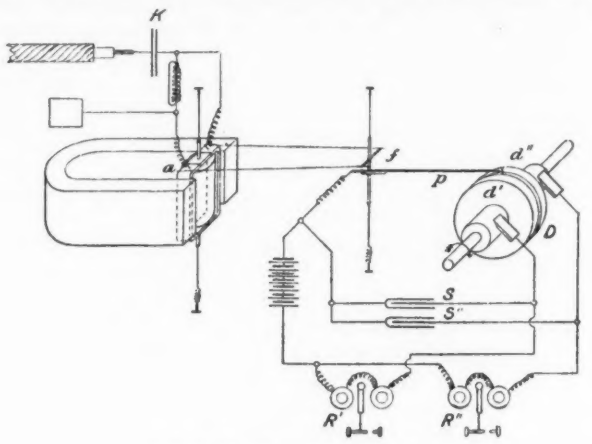


DIAGRAM OF CABLE RELAY.

galvanometer part of the siphon recorder are to the left. The moving coil is harnessed to *f* by two silk or quartz fibers. The pointer *p* is a fine siphon-glass tube, carrying through its bore a phosphor-bronze wire with an iridium tip for the contact. The drum *D* is in three sections, of which *d'* and *d''* are connected for the dot and dash deflections. The middle section is insulated, and is merely a resting place for the contact pointer. There it rests, whatever is sent into the cable, unless the drum be rotated. When, however, the drum is driven at, say 150 revolutions per minute, the contact friction that makes the pointer stick is removed, and the pointer obeys the impulse of the recorder coil and gives dot and dash currents in the relays *P'* and *P''*. Two condensers, *S'* and *S''*, are used in the battery circuit to the relays; they are said to greatly improve the contact between the pointer and the drum. To stop earth currents, and for other reasons, signalling on cables is done through a condenser, *K*. The condenser becoming charged under a succession of signals of the same sign, there is a variable zero, which would be fatal to the action of the relay; to get rid of it, he devised what he calls the "local correction." A current from a local battery and the relays

R' R'' is sent through a circuit "having the proper (large) retardation." This circuit is made up of a condenser placed between two high resistances, condenser and resistances being capable of minute adjustment; the relays R' R'' produce the same order of signals as that which charges up the condenser K. As the current from the cable, due to the choking action of the condenser, dies away, so at exactly the same rate does the current from the local correction circuit increase. The correction current flows through a separate winding on the suspended coil a in the same direction as the signals, so as to compensate for the loss of current from the cable, thus eliminating "variable zero" disturbances. A "magnifying relay" is also briefly described. It has not yet come into use; it is a modification of the above relay.—Lond. *Elec. Times,* May 8; Lond. *Eng'ing,* May 9.

Theory of Wireless Telegraphy.—R. KENNEDY.—An illustrated article on "electromagnetic oscillations." Marconi's achievement disposes of the assumption of the rectilinear propagation of the waves. He believes that the effects are not due to ethereal waves traveling as light does, but to electrical oscillations set up in the earth itself considered as a whole sphere, insulated in space, and the same effects can be reproduced on a small scale on a large ball, or artificial earth, as it may be called. "In this view of the electromagnetic transmission of waves, we can imagine the rapid discharges at great potential at one point agitating the whole electrical system of the earth, and that the earth is surrounded by an electrical atmosphere normally at rest and neutral, so that when disturbed at one point, this atmosphere vibrates or oscillates throughout its whole mass. And, therefore, there is no reason why communication between antipodes should not be practicable." He considers a wireless telegram to be actually an effect of the surface charge of the earth as a whole, and not at all due to radiant energy traveling in space like a ray of light. He describes a model telegraph, without wires over a large globe, under the assumption that the globe can be charged electrically, and the charge can be reversed at will.—Lond. *Elec. Rev.,* April 25, May 2.

REFERENCES.

Central Energy Systems.—CLAUSEN.—An article illustrated by diagrams, on "central energy systems of to-day; Independent vs. Bell."—*Tel. Mag.,* April.

Multiplex Telegraphy.—ANIZAN.—The first part of a well illustrated description of the Mercadier multiplex telegraph.—*Jour. Teleg.,* April 25.

Statistical.—Comparative statistical tables on telegraphy in various countries in 1900 (the United States not being included); continuations of the article on the effects of the 1899 telephone tariff upon the development of the telephone service in Germany; also of the article on telegraphy and telephony in Belgium in 1900.—*Jour. Teleg.,* April 25.

MISCELLANEOUS.

REFERENCES.

Magnetic Separator.—A well illustrated description of a magnetic separator of the Brit. Thomson-Houston Company.—Lond. *Eng'ing,*

Cornu.—An account, with portrait, of the life and work of the late Prof. Cornu.—*L'Eclairage Elec.,* April 19.

Morton.—An account, with portrait, of the life and work of the late Dr. Henry Morton.—*Eng. News,* May 15.

New Book.

LOGARITHMIC TABLES. By Thos. W. Marshall. New York: The Engineering News Pub. Company. Flexible leather. 106 pages. Price, $2.

The contents of this book consist of a set of tables of seven-place logarithms of feet and fractions of feet from $^1/_{16}$ inch to 50 feet, in steps of $^1/_{16}$ inch; a table giving values of inches and fractions of an inch in terms of a foot, and a preface explaining the application of the logarithmic tables. Just why these should require any explanation is not clear; they give the logarithms of dimensions that are expressed in feet, inches and fractions of an inch, and can have only one possible use—that of facilitating the multiplication or division of one dimension in mixed units by another. The book should be of considerable convenience to bridge engineers or others whose work involves computations in the mixed units on which the tables are based.

Directory of Electrical Societies, Etc.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Next meeting, Pittsburg, June 28 to July 3, 1902.

AMERICAN ELECTOCHEMICAL SOCIETY. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Extra meeting, 220 West Fifty-seventh Street, New York, May 28; annual convention, Great Barrington, Mass., June 18-21, 1902.

INDEPENDENT TELEPHONE ASSOCIATION OF WISCONSIN. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES. Next meeting, Philadelphia, Pa., June 24, 25 and 26, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Chicago, May, 1903.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

OHIO STREET RAILWAY ASSOCIATION. Next meeting, June, 1902.

SOCIETY FOR PROMOTION OF ENGINEERING EDUCATION. Next meeting, Pittsburg, June 28 to July 3, 1902.

Absorption of Sprague Electric by General Electric.

The reported pending purchase by the General Electric Company of the stock, or a majority of it, of the Sprague Electric Company is one of great interest to the electrical industry. It is understood that the sale is the culmination of various negotiations which, in one form or another, have been pending for over a year. The terms, according to the president's circular to the Sprague Company stockholders, are, so far as it affects them, as follows:

For the 5 per cent. debenture bonds: 55 per cent. in Otis preferred stock, now quoted at 102, and 45 per cent. in cash.

For preferred stock: share per share in 3½ per cent. General Electric 40-year gold debenture bonds, with the right of redemption at par within ten years, and 105 after ten years.

For common stock: 41.9 per cent. of par in Otis common at par, now quoted at 32, and 21.42 per cent. of par in the 3½ per cent. debentures.

All provided 75 per cent. of each class of securities assents, which amount is already assured by the action of the principal stockholders. All stockholders are treated alike. According to probable valuations of the various securities, the equivalent cash prices are therefore about 101 for the bonds, 95 for the preferred stock, and 30 to 35 for the common.

The reasons for the purchase of the Sprague Company, the price paid for its patents and good will, and the probable effect on the electric railway situation are matters of interest. The Sprague Company is a busy, solvent, going concern, with a fine factory, developing under inventions, etc., of Messrs. Sprague, Lundell and Greenfield. According to a recent statement, it had, exclusive of patents and good will, something over $2,700,000 assets, against $1,100,000 liabilities (exclusive of capital stock), or, say, $1,600,000 of net assets, of which over $300,000 was in cash. Besides the nominal assets and liabilities of the Sprague Company, the Sprague Company is under a long-time contract with Mr. Sprague, which, it is rumored, is in certain respects modified as a condition of purchase. It is reported that the total present payment to be made by the General Electric Company for the net assets of $1,600,000, and for the patents, good will and contracts, amount to nearly $2,500,000 in 3½ per cent. debenture bonds, and $850,000 in Otis common stock. It would, therefore, seem that about $1,250,000 has been paid for patents and good will.

The real reason for the purchase apparently lies in the possession by the Sprague Company of what are claimed to be the master multiple-unit patents, covering the operation of existing elevated railroads in Chicago, Brooklyn, New York and Boston, and the systems which are to be used on the Rapid Transit and other roads, the practical development of the multiple-unit system dating from Mr. Sprague's work in Chicago.

For a long time there has been a very active patent contest between the Sprague Company and the General Electric and Westinghouse Companies, the former having brought suit on its multiple-

unit patents, and having just closed its *prima facie* case, and the latter having brought suit on various patents which it claims the Sprague Company was infringing. The warfare over these patents is said to have been costing the opposing interests fully $100,000 a year, with little likelihood of an end for some years, yet with the possibility that the multiple-unit patents might be upheld, with consequent grave results where large contracts are concerned. It is also understood that, as in Boston on the elevated railway, tests of apparatus have been proposed by the Rapid Transit Company. These are not only necessarily expensive to carry out, but the result of which would be entirely in doubt, for the Sprague Company is said to have determined to actively take up railway motor construction.

Pending the settlement of the various patent suits and the carrying out of competitive tests, the public, rather than the manufacturing companies, would possibly be the financial gainers, and it therefore seems advisable to the various interests, some of which are interested in both the General Electric and the Sprague Companies, to come to an understanding, which is represented by the offer which has been made and accepted.

Under the circumstances it seems fair to say, therefore, that the multiple-unit patents and interest created by Mr. Sprague within the past few years have been sold for fully $1,000,000, and it curious to note that a single inventor has twice created an epoch in electric railway operation, as well as one in stationary motors and one in elevators, and that his electric interests have each time finally come into possession of the same company, outside of elevators. It will be remembered that the Sprague Company's interests in electric elevators were some time ago sold to the Otis Elevator Company for something over $1,000,000.

This deal apparently affects the United States alone, as it is understood that the Sprague Company is not prosecuting railway business abroad, and has no interest in Mr. Sprague's patents there. The effect upon public interests of this wise and strategic move by Mr. Coffin cannot be exactly foretold. It means the probably certain upholding of the multiple-unit patents, and in that way sure control of suburban and interurban electric railway developments by the General Electric Company and its allied interests. It is likely, however, that the best points of the apparatus which has been designed by the various companies will ultimately be combined, and the railway companies will not only get more matured and perhaps better apparatus, but will be relieved from the contending claims and dangers due to divided ownership in matters of vital concern.

As to Mr. Sprague's personal future, it appears that his activities will not necessarily be any less effective, but that he will be in a position to do freer work where the larger railway problems are concerned, and, indeed, it is understood his connection with the Sprague Company continues under some specific agreement.

The Nernst Lamp.

We present herewith illustrations of the Nernst lamp in some of its commercial forms as developed in this country. Those who have seen this lamp in operation can have but one opinion as to the character of the illumination which it furnishes, which approaches nearer to that of daylight than any other commercial source of artificial light. So excellent is the light in this respect that even if handicapped by an efficiency much less than that of the incandescent or arc light, its older rivals would be out of competition where quality of light is a desideratum. In efficiency, however, tests have shown that the Nernst lamp is on a parity with the enclosed arc, and has double the efficiency of the incandescent lamp. The comparison with the enclosed arc lamp is still further strengthened by the flexibility of the Nernst lamp, which can be installed in units ranging from 528 watts corresponding to the enclosed arc, down to 88 watts, the efficiency being practically the same for all the units. Yet another advantage in this connection is the uniformity of the light and its superior distribution for many purposes, ninety per cent. of the illumination being well below the horizontal.

Four sizes of the lamp have been perfected, namely, the one-glower lamp, consuming 88 watts; two-glower lamp, consuming 176 watts; three-glower lamp, consuming 264 watts, and four-glower lamp, consuming 528 watts. Each glower is equal in candle-power to three ordinary 16-cp incandescent lamps. The life of a glower is about 800 hours on 60 cycles and 400 hours on 25 cycles, the life of the heater being about 2,500 hours. The power factor is unity. The one-glower lamps are provided with an Edison base, and thus may be inserted in the ordinary incandescent lamp socket.

Fig. 1 shows the essential parts of a Nernst lamp, and a circuit diagram is given in Fig. 2. The "glower" is the light-giving element, and consists of a small white rod about $^1/_{32}$ inch in diameter and 1 inch long. It is fastened to the "holder" mechanically and electrically by means of terminal wires and small aluminum plugs. The glower is a non-conductor when cold, becoming, however, a conductor when heated.

The "heater" is made up of two or more small white porcelain tubes about the size of a lead pencil. These have been wound with fine

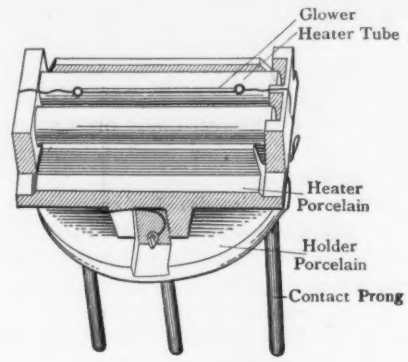


FIG. 1.—PARTS OF LAMP HOLDER.

platinum wire, and in turn covered with a refractory paste which protects the wire from the intense heat of the glower. These tubes are mounted on the "heater porcelain," which constitutes a part of the holder. The "holder" is the removable part of the Nernst lamp upon which the glowers and heaters are mounted. The contact terminals and prongs, by which the current is conducted to the heater and glowers, also constitute a part of the holder. The "ballast" is a steadying resistance connected in series with each glower. It is enclosed in glass and mounted in the body of the Nernst lamp.

The "cut-out" is the automatic device for preventing waste by

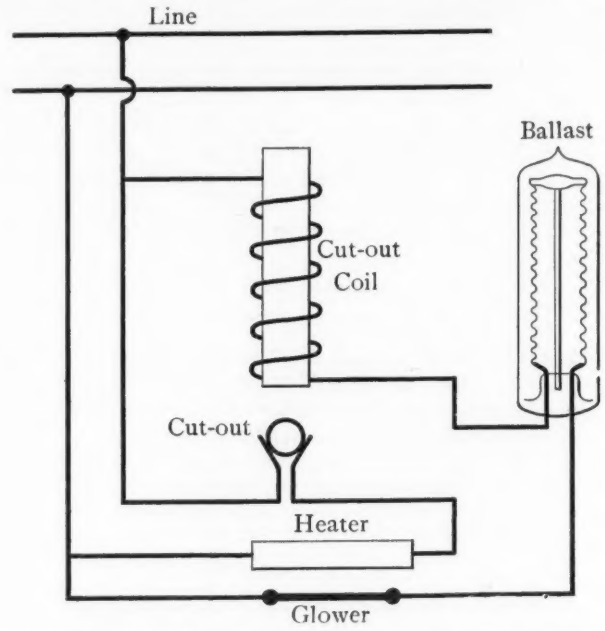


FIG. 2.—DIAGRAM OF ARRANGEMENT AND CONNECTION OF PARTS.

interrupting the heater current after starting the glowers. The heater and glowers are connected in parallel. The current taken by the glowers is passed through the coil of the cut-out. When the glowers are taking no current, as in starting, the cut-out armature closes the heater circuit by resting upon two contact pins. As soon as the glowers take current, however, the cut-out coil lifts the armature from the contact pins, thus disconnecting the heater from the circuit. The various parts and their connections are arranged as shown in the accompanying diagram (Fig. 2) of a one-glower Nernst lamp. The same principle is adhered to in all the other sizes and styles.

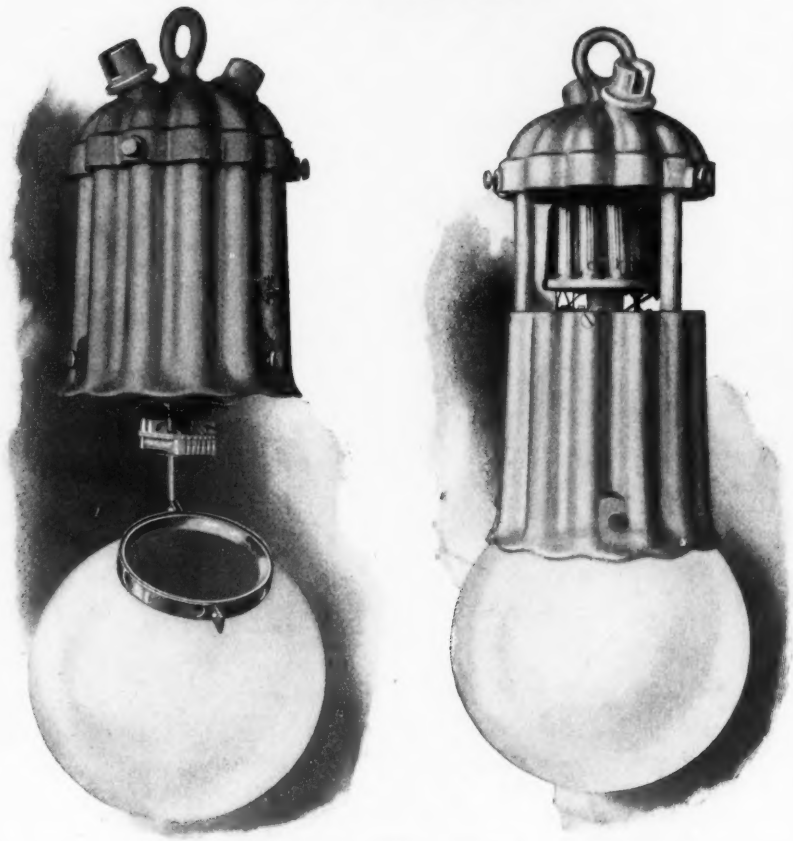
When a dome shade is used, the large Nernst lamps are provided with a small inner globe, termed the "heater case." This is to be slipped over the holder into three springs which extend slightly below

FIG. 3.—INDOOR TYPE OF LAMP.

FIG. 4.—CEILING CLUSTER SINGLE-GLOWER LAMPS.

FIG. 8.—HOLDER BOXES.

FIG. 5.—THIRTY-GLOWER INDOOR TYPE OF LAMP.



FIGS. 6 AND 7.—SIX-GLOWER OUTDOOR TYPE OF LAMP.

VARIOUS STYLES OF NERNST LAMPS AND HOLDER BOXES.

the petticoat of the Nernst lamp housing. The heater case may be dispensed with entirely when outer globes are used.

In Fig. 3 is shown a one-glower lamp with an opal dome shade, and in Fig. 2 the same unit as enclosed for use in a ceiling cluster. Fig. 4 shows a three-glower indoor lamp, and Fig. 5 a six-glower indoor lamp. Figs. 6 and 7 illustrate a six-glower outdoor lamp, the ballast tubes being visible in the former figure.

Fig. 8 shows the manner in which the removable element of the Nernst lamp is packed. As taken from the case, the part is ready for operation when the holder has been firmly pushed into place and the shades or globes attached. When a renewal is required, the part is returned to the case and shipped to the factory to be refitted and returned.

Wattmeter Error Calculator.

The mechanical calculator shown herewith is for use in deterining quickly the error of wattmeters by solving the general meter formula:

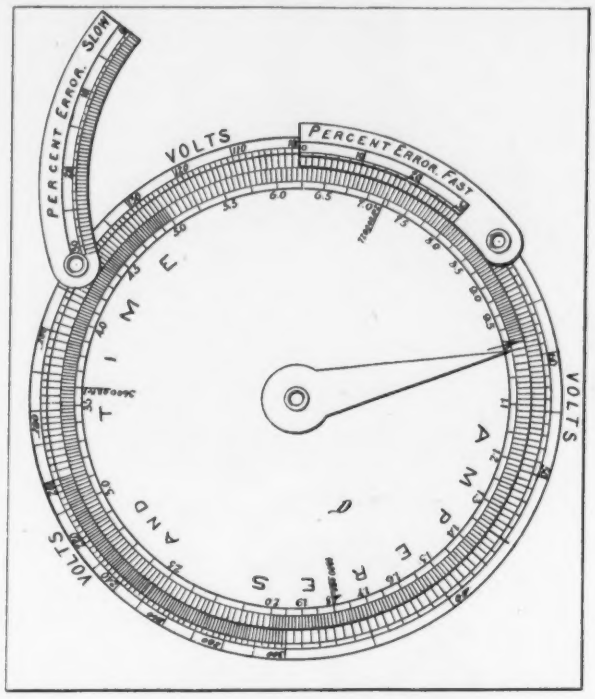
$$\frac{EI - \frac{3600\,K}{T}}{EI} \times 100$$

in which E is the e. m. f., I the current, T the time and K the meter constant.

The usual way of testing electric recording-wattmeters is to place an ammeter and a voltmeter in the circuit supplied by the meter, and then note the time required for one revolution of the meter-disk when a definite current is flowing through the meter at a definite voltage. From the data thus obtained, and the meter constant supplied by the manufacturer, the error may be quickly, accurately and conveniently obtained by mechanically actuating the parts of the calculator and then reading the indicated results.

On a base of celluloid or cardboard is arranged a graduated circle indicating the voltages likely to be met with in practice and laid off logarithmically. Concentric with this is an inner pivoted circle, graduated to amperes and time, and divided logarithmetically into ten parts and subdivisions. On the same pivot is mounted to turn independently a pointer for the purpose of indicating points on the two above-graduated circles. Two hinged percentage scales are arranged to overlie the outer graduation, one scale indicating slow, and the other fast errors.

To use the instrument, the current reading on the movable scale is placed opposite the volt reading on the fixed scale, and the pointer is placed over the zero reading on the graduation on the movable scale. Then the time reading on the movable graduation is placed under the pointer, and the percentage error of the meter fast or slow is then indicated on the percentage scale by the line on the movable graduation, which indicates the constant of the meter. The meter-constant lines may be conveniently represented on the movable scale by figures corresponding to the constant or multipliers as given by the manufacturers. Thus the meter-constant line for a meter whose multiplier as stated by the manufacturer is two, is located at the logarithmic-scale line for thirty-six hundred multiplied by three or seventy-two. If the meter is correct, the meter-constant line indicates zero error. It is noted that the fixed voltage scale is laid off in a direction opposite to that of the movable ampere and time graduation. The calculator described is the invention of A. T. Beauregard, Darien, Conn.



WATTMETER ERROR CALCULATOR.

Automobile Brake Tests.

On May 1, last, trials were held on Riverside Drive, New York City, of automobile braking. According to the report of the Technical Committee of the Automobile Club of America, which conducted these tests, the results were favorable to automobiles, as compared with other vehicles driven by other means. The tests lasted for an hour and a half, during which time about 90 runs were made. The speeds were determined by running the vehicles over a course of one-tenth of a mile, or 528 feet in length, and the time was measured by a stop watch, electrically connected with the starting and finishing points. This apparatus constitutes the Mors timing instrument belonging to the club. The average results were as follows: 17 different types of automobiles, running at about 8 miles per hour, stopped in an average distance of 9 feet. At a 15-mile speed the stop was accomplished in an average distance of 29 feet, and at 20 miles the average distance was 53 feet. Similar tests were simultaneously

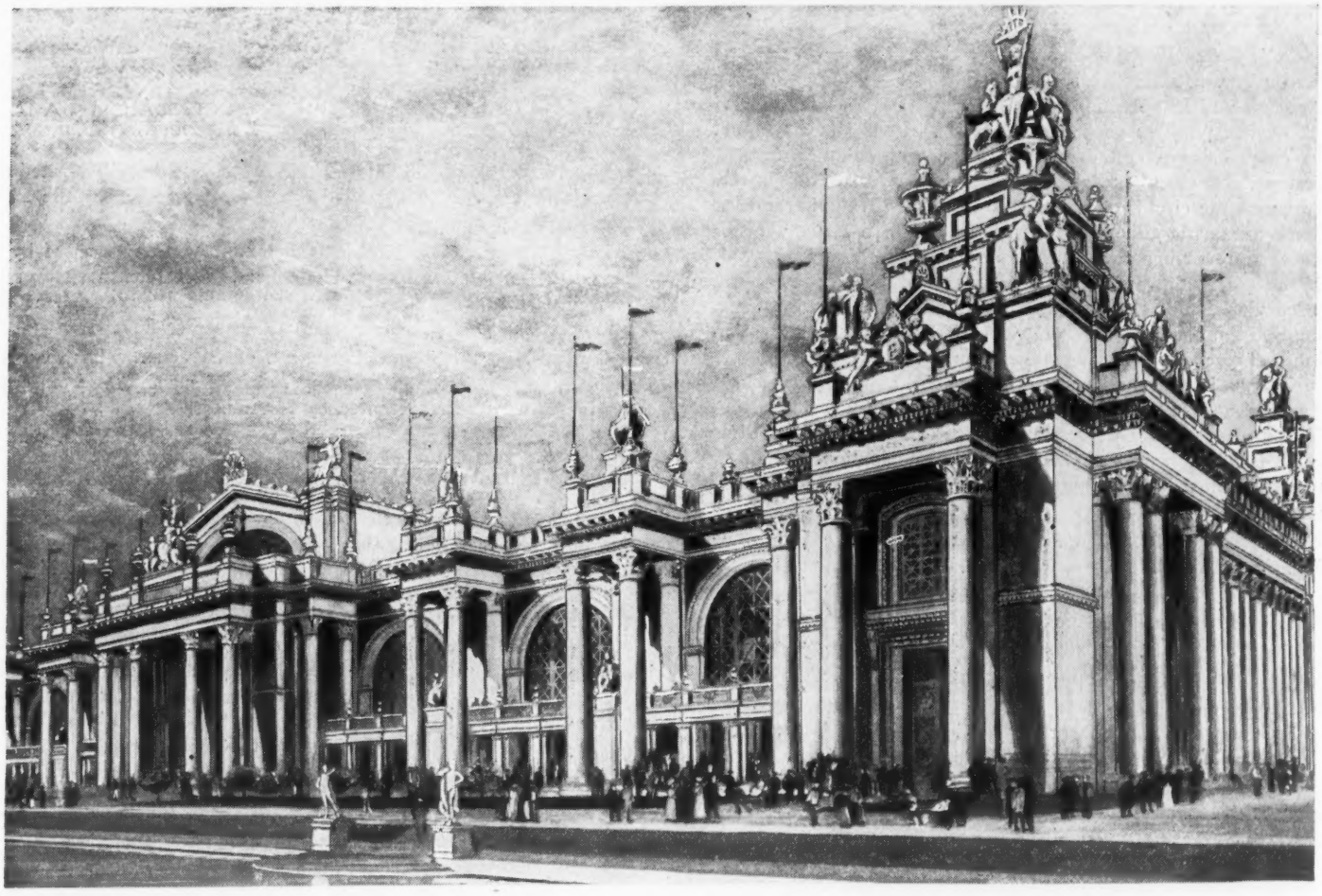
Figs. 1 and 2.—Automobile Brake Tests.

conducted with reference to a victoria drawn by two horses, a four-in-hand coach and a bicycle-mounted policeman. The victoria, at the 9-mile rate, required 17 feet 8 inches in which to stop; the coach, going at the same speed, required 26 feet, and the policeman on the bicycle, going at 9.4 miles, stopped in 8 feet. At the 15-mile rate, the victoria stopped in 37 feet and the four-in-hand in 77½ feet. At the 20-mile rate, the policeman stopped in 61½ feet and the four-in-hand coach in 91 feet. The tests showed conclusively that automobiles can be stopped in a much shorter distance than can other vehicles. They also proved that automobiles can be manœuvered with great ease and convenience. A report of the test to the governors of the Automobile Club is signed by Dr. S. S. Wheeler, chairman of the technical committee. The two accompanying views show an automobile under way and the time recording instruments under the supervision of the judges.

Electricity Building, St. Louis Exposition.

Although the opening of the St. Louis World's Fair has been deferred until 1904, the work of preparation for that event continues with sustained vigor. In the Department of Electricity substantial progress has been made, and an interested co-operation on the part of electrical manufacturers has been developed. Prof. Goldsborough, chief of the Department of Electrical Exhibits, reports that the representatives of the department have been met with hearty assurances of support.

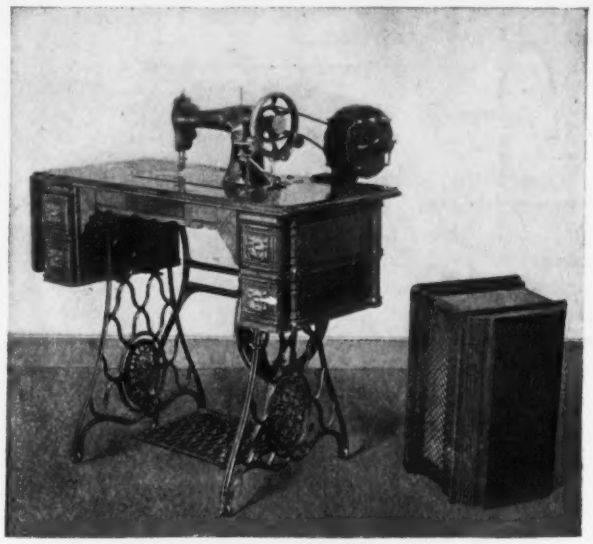
In this connection it is now interesting to show a general view of Electricity Building as it will appear when finished. This building, as has already been pointed out, will have a frontage north and south of 650 ft., and toward the east of 525 ft., and a floor space of 350,000 sq. ft. The plans provide a balcony on all four sides of the interior, which will afford additional exhibit space amounting to 100,000 sq. ft. As will be seen from the illustration, the design of the exterior is a bold treatment of the Corinthian order of architecture, and the important matter of light has been duly considered and provided for in the ample window space.



GENERAL VIEW OF ELECTRICITY BUILDING, ST. LOUIS EXPOSITION.

Sewing-Machine Motor.

The illustration herewith shows a General Electric motor of special type for the operation of sewing machines. These motors are compact and simple of construction and are readily installed to machines for domestic use. They can be attached to most of the standard sewing machines. The speed is controlled by pressure on the treadle, and the machine can be instantly stopped by removing this pressure.



SEWING MACHINE MOTOR.

Change from motor power to foot power is readily accomplished.

These motors in size and construction are similar to the company's fan motors, but in place of the ordinary pedestal base they are provided with a frame casting, having a clamping foot for attaching to the table of a sewing machine. They can be connected to a lamp socket or wall receptacle by means of a flexible cord and plug. A small snap switch placed on the under side of the machine table

enables the operator to stop and start the motor without leaving the machine. The motor is clamped to the back of the machine table so that the pulley is brought in line with the pulley on the sewing machine hand wheel. The pulleys are connected by a small round leather belt, the length of which is such that the machine will not take power from the motor unless the belt is tightened by pressure on the idle pulley on the rocker arm. The machine is controlled entirely by the foot treadle, the process of starting and stopping being the reverse of each other. These motors are wound for 115 volts, direct current, and for 52 or 104 volts, and 60 or 125 cycles, alternating current.

Convention Exhibit Echoes.

In ELECTRICAL WORLD AND ENGINEER last week, a large amount of space was devoted to notes of the exhibits and representatives at the Cincinnati meeting of the National Electric Light Association. As much material as could be prepared and forwarded and printed for inclusion in that issue was then given, but we are now able to supplement that data with further items as to other concerns, late comers and closing episodes.

MR. N. F. BRADY, treasurer of the New York Edison Company, gave a charming little informal lunch in the gentlemen's ordinary at the Grand on Thursday. Among those participating were Messrs. Doherty, Ferguson, S. Insull, A. Williams, J. I. Ayer, E. A. Leslie, J. B. Cahoon, and others prominent in the Association work; 14 in all being present. Mr. Brady proved himself, as usual, an excellent host, and a delightful hour of chat and good stories was enjoyed as an interlude to the hard work on the convention floor.

THE MOERLEIN BREWERY, one of the really great institutions of Cincinnati, was cordial in its invitation to the delegates, and a great many availed themselves of the opportunity to inspect that fine, modern establishment. A few of them were persuaded to try the beer, and pronounced it good. The plant is equipped with some very interesting up-to-date machinery.

MR. J. JONES, JR., who represented J. Jones & Son, of New York, at the convention, had several interesting novelties on view in his rooms, wired up and in operation. These included an automatic time cut-out device, purely mechanical in its operation; the alarm hand of the clock being operated in exactly the same manner as in an ordinary alarm clock, except that the trigger of the alarm in this case works on the circuit opening arrangements. In similar manner the Jones automatic time switches work with two cams which travel together, revolving once every 24 hours, being easily set to operate the switch at the proper time, after which the clock does the proposed work. For sign and window lighting the device is extremely handy. Another form is of the periodic commutating type. Mr. Jones showed also an ingenious rotary ceiling switch of the jack-knife type, in the regular snap connections, and only one chain pull. Another new device is a neat show-case lighting fixture of great flexibility as to adjustments, and constituting an admirable improvement for such work as show window illumination. The firm distributed a neat little pocket memordanum book crammed with information.

MR. L. D. SKINNER, JR., of the Skinner Engine Company, Erie, Pa., was in attendance.

MR. A. M. BARROW, the consulting engineer of Chicago, met several of his old and prospective clients.

MR. W. O. GARRISON, the president of the Columbia Incandescent Lamp Company, was a heartily-greeted participant in the various exercises and functions.

MR. H. P. BALL, engineer of the General Incandescent Arc Light Company, took part in the proceedings.

ELECTRIC APPLIANCE COMPANY, of Chicago, were wholly and adequately represented by their versatile Mr. W. W. Low, as well as by Messrs. G. B. Fairbanks and A. L. Willard.

CHICAGO INSULATED WIRE COMPANY were represented by Mr. W. M. Smith.

MR. I. F. BRINKMAN, the electrician of Lawrenceburg, Ind., came to the convention for the closing days.

MR. J. A. VAIL appeared on behalf of the Hooven, Owens & Rentschler Company, of Hamilton, O., whose engines are becoming favorably known in the electrical field.

GLOBE WERNICKE COMPANY, of Cincinnati, whose files, etc., have been a boon to many a central station man, were represented by Mr. E. K. Pritchett. The large store was also visited, as well as the factory, which has been electrified with a thorough equipment of Triumph motors.

MR. C. R. BISHOP, of the American District Steam Company, of Lockport, was one of the last to register.

THE ERNER-HOPKINS COMPANY, of Columbus, O., were represented by Mr. W. A. Hopkins, Jr., of that city.

DEARBORN DRUG AND CHEMICAL COMPANY were represented by Mr. Dan Delaney, of Cincinnati, and Mr. R. W. Francis, of Chicago.

JANTZ & LEIST ELECTRIC COMPANY were represented by Mr. C. T. Schlochtermeyer.

GREEN FUEL ECONOMIZER COMPANY sent Mr. W. J. Best from their Chicago Office.

SANDERSON & PORTER, the engineers and contractors of New York, were represented by Mr. W. A. Haller, of Galveston, Tex.

FAYERWEATHER & LADEW, the leather belting people, sent Mr. P. M. Burton, of Indianapolis.

MOLONEY ELECTRIC COMPANY, of St. Louis, were represented by Mr. T. A. Moloney, to speak in behalf of the good points of their well-known transformers.

CENTRAL ELECTRIC COMPANY, of Chicago, was represented by Mr. Allen S. Pearl.

HILL CLUTCH COMPANY, of Cleveland, was represented by Mr. H. W. Hill.

MCROY CLAY WORKS were on hand in the person of Mr. E. F. Kirkpatrick, their Chicago agent.

ROYAL ELECTRIC COMPANY, of Peoria, Ill., sent their well-known principal, Mr. G. G. Luthy.

MR. OSCAR CARMAN attended in behalf of the interests of Mr. R. L. McOuat.

MR. T. G. GRIER, of Chicago, met a great many old friends while circulating in the interests of the American Circular Loom Company.

AMERICAN ELECTRICAL WORKS, of Providence, were represented by Mr. F. E. Donohoe.

PROF. C. P. MATTHEWS dropped in from Purdue University, Lafayette, Ind., to take part in lamp discussions.

MR. W. J. PHELPS, by his method of handshaking, illustrated very clearly the high and low features of the lamps made by the Phelps Company.

LUNKENHEIMER COMPANY, of Cincinnati, were represented by Mr. David C. Jones, S. L. Moyer, and others. Most central station men proved on examination to be well posted as to their excellent valve and other specialties in the steam and mechanical line.

CROUSE-HINDS ELECTRIC COMPANY, of Syracuse, whose excellent switch and board work is winning deserved encomiums from central station men, were represented by Mr. Hinds.

MANHATTAN ELECTRIC SUPPLY COMPANY, of New York, sent Mr. J. W. McDowell from the home office.

HIGH LIFE BELOW STAIRS.—One of the most interesting exhibits referred to briefly last week was situated on Central Avenue, several blocks from the hotel. Carriages were kept busy conveying personally conducted parties, under the able management of Mr. B. S. Barnard, of The American Vitrified Conduit Company, who took all his friends to the exhibit, which means that practically everyone attending the convention went. The exhibit consisted of one of the manholes of the underground conduit system, which had been fitted up by Mr. G. M. Gest, the contractor, with carpets, rugs, portieres, divans, lamps, etc., until the manhole was transformed into a veritable Oriental subterranean parlor, except that it contained a washbasin, a telephone, an electric fan and an ice-chest, which are probably not usually found in Oriental parlors. A few papier-maché snakes, skulls and other weird ornaments contributed to the oddity of the situation. Mr. Gest, with true hospitality, provided the visitors with refreshments. The temperature being also much lower than on the street, helped very much to make the visit a relief from the strenuousness of the hotel corridor life, and many men sought peace there. The conduits leading into and out of the manhole will carry 150 cables. About 1,000,000 feet of the conduit is being laid in Cincinnati by Mr. Gest, who has several other large conduit contracts in hand in American cities.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was in good supply with a light demand, the closing rates being 4½@5 per cent. for 30 to 90 days, and 4½ per cent for longer arrangements. In the stock market favorable crop reports and easier money rates had a good effect; heavy covering of shorts ensued, after which the market became quieter. Amalgamated copper advanced on the improvement in copper prices. There was more activity in the traction list, the prices closing at an advance over previous quotations. Brooklyn Rapid Transit closed at 68¼, which was within ¼ of the highest price of the week, the lowest being 64¼; the net gain was 3½ points, 40,650 shares having been sold. Metropolitan Street Railway closed at 150, a net gain of 3¼ points; the closing figure was ¼ point below the highest of the week, the lowest price being 146¾. The sales of this stock aggregated 50,900 shares. The electric stocks were generally quiet, General Electric closing at 315, which figure was two points below the highest of the week, the lowest quotation being 314. The shares sold aggregated 2,600. Westinghouse, common, closed at 215, which was the highest figure of the week, and representing a net gain of 7 points, while the first preferred closed at 210, a net loss of 8 points. Western Union reached 91⅞ and closed at 91⅛, a net gain of 1⅛ point. American District Telegraph closed at 38, a net loss of 2 points, and American Tel. & Tel., 178, a net loss of 2 points. Following are the closing quotations of May 27.

NEW YORK.

	May 20.	May 27.		May 20.	May 27.
American Tel. & Cable.	90	90	General Carriage	2⅜	4
American Tel. & Tel...	177	176½	Hudson River Tel.....	—	—
American Dist. Tel.....	38	—	Metropolitan St. Ry....	148	147¾
Brooklyn Rapid Transit.	66	66⅞	N. E. Elec. Veh. Trns..	1¼	—
Commercial Cable	161½	151	N. Y. E. V. T. Co.....	13⅝	13¼
Electric Boat	28	25	N. Y. & N. J. Tel.....	166	—
Electric Boat pfd	48	45	Tel. & Tel. Co. Am....	—	—
Electric Lead Reduc'n..	3	—	Western Union Tel.....	90	90½
Electric Vehicle.....	5	7	West. E. & M. Co.....	212	212
Electric Vehicle pfd	11½	14¾	West. E. & M. Co. pfd.	—	216
General Electric	316¼	315			

BOSTON.

	May 20.	May 27.		May 20.	May 27.
American Tel. & Tel....	178	178	Mexican Telephone	2¼	2¼
Cumberland Telephone .	—	—	New Eng. Telephone....	146	147
Edison Elec. Illum.....	—	—	Westinghouse Elec.	—	—
Erie Telephone	—	—	Westinghouse Elec. pfd.	—	—
General Electric pfd....	315	315½			

PHILADELPHIA.

	May 20.	May 27.		May 20.	May 27.
American Railways	46	46	Phila. Traction	97½	97¼
Elec. Storage Battery...	87½	88	Phila. Electric	5¼	5¼
Elec. Storage Bat'y pfd.	87½	88	Pa. Elec. Vehicle	1¼*	—
Elec. Co. of America....	7⅛	7	Pa. Elec. Vehicle pfd....	4*	—

CHICAGO.

	May 20.	May 27.		May 20.	May 27.
Central Union Tel.....	—	—	National Carbon pfd....	91¾	93
Chicago Edison	174	175⅛	Northwest Elev. com....	—	37
Chicago City Ry.....	—	207	Union Traction	18¾	18⅜
Chicago Teleph. Co.....	—	175*	Union Traction pfd.....	—	52½
National Carbon	25½	24½	*Asked.		

MAHONING VALLEY TROLLEYS.—The Pennsylvania and Mahoning Valley Railroad Company has been incorporated under the laws of Pennsylvania, with a capital stock of $8,000,000. The company represents a consolidation of the Trumbull Electric Company, the Mineral Ridge Railway Company, the Mahoning Valley Railway Company, the Newcastle and Lowell Railroad Company, the Newcastle Traction Company, the Lawrence Gas Company, and the Newcastle Electric Company. The combine has also purchased Cascade Park, near Newcastle. It controls 90 miles of track, reaching from Leavittsburg, Ohio, to Newcastle, Penn. The following officers have been chosen: President, M. A. Verner, Pittsburg; vice-president, James Parmlee, New York; secretary, John E. McVey, Youngstown, Ohio; general manager, A. A. Anderson, Youngstown. The company was organized by Col. Myron T. Herrick, James Parmlee, and Benjamin F. Miles of Cleveland, who own a controlling interest in the combined properties. The capital stock of $8,000,000 is divided into $3,000,000 5 per cent. preferred and $5,000,000 common stock. Ultimately it is expected that the road will be a part of a system that will have a through traffic arrangement between Cleveland and Pittsburg. The Eastern Ohio Traction line is now built within a few miles of Leavittsburg, the western terminus of the Pennsylvania and Mahoning Valley Company's road, and is being pushed rapidly forward. From the eastern terminal at Newcastle, Pittsburg capitalists are building an electric line that will shortly be completed, and with which it is expected through service will be arranged into Pittsburg.

INTERNATIONAL POWER.—Soon after the collapse in the price of International Power Company stock, Joseph H. Hoadley, the president of the company, announced that he had requested Harvey Fisk & co. to make an examination of the company's affairs, with a view to giving the stockholders and others who had been caught in the collapse an idea of what the company really owned. The examination, which was made by Haskins & Sells, public accountants, has been made public. The report shows that practically all the statements made by officers and friends of the company when the stock was being sensationally advanced were incorrect. One of the most common statements made at the time was that the company was earning enough to pay dividends at the rate of 10 per cent. on the common stock. The net earnings of the company, as shown by the report for the year ended December 31 last, were $50,005, and the total income from all sources, including dividends from the American Locomotive Company and other sources amounted to $292,796. From this amount must be deducted $47,328 as interest on fixed obligations. The surplus is therefore $245,467. Out of this must come the dividends on the preferred and common stock. At the rate of 6 per cent. on the preferred and 10 per cent. on the common it requires $676,000 to pay a year's dividend on both classes of stock, assuming that dividends are paid on all stock issued. It is stated by the president that the company has orders enough ahead for Diesel engines and auto trucks for shipment abroad alone, aside from orders from this country, to run all its factories continuously for several years.

TELEGRAPH POLICIES.—The election of Mr. Bradley of the Postal Telegraph as a director of Iowa Central, following the election of Mr. John W. Mackay as a director of Minneapolis & St. Louis and of Mr. George Crocker as a director of Postal Telegraph, suggests a possibility that in the not far distant future the Postal Telegraph may supersede Western Union along the lines of Minneapolis & St. Louis and Iowa Central, both of which companies are believed to be dominated by Mr. Crocker. The present installation by the Postal Telegraph Co. in the Arcade Building in Philadelphia is the first by that company in a building controlled by the Pennsylvania Railroad. An official of the Pennsylvania Railroad says: "I do not see any possible chance of the resumption of relations between our company and Western Union. The differences between us have been of long standing, all efforts to come to an agreement having failed, and I am fully convinced that our notice that the compact is to end is final."

LONG ISLAND CONSOLIDATION.—It is announced that a new corporation is to be formed shortly with $3,000,000 capital stock, and $2,500,000 first and collateral trust mortgage four per cent. fifty year bonds, which will be exchanged for the securities of the following companies: Staten Island Electric Railroad, at par; New York and Staten Island Electric Company, at 120 for bonds (interest to be adjusted in cash) and $30 for stock; New Jersey and Staten Island Ferry Company, at par for bonds and 10 for stock, and the Richmond County Power Company, at 125. The capital stock of the new company is to be represented by a five years' voting trust, composed of H. H. Rogers, Walter G. Oakman and William L. Bull. The cash working capital will be $438,880. The new securities are underwritten.

ATTACKING SUPPLY "TRUST."—According to advices from Chicago, complaint is to be filed with Attorney General Knox that the Electrical Supply Dealers' Association of the United States is a trust. Information is being collected by independent electrical supply dealers. When they act, which will be soon, they will ask the Attorney General to proceed against the association under the Sherman law as being a body that acts arbitrarily and illegally in restraint of trade, and to crush competition. The names of the "independents" referred to are not given.

THE CANTON-AKRON RAILWAY COMPANY has executed a mortgage for $2,000,000 to the Knickerbocker Trust Company, of which $850,000 is reserved to retire the bonds of the Canton-Massillon Company now owned by the same people, and $400,000 will be reserved for future improvements. The balance will be used in getting the road into operation. The bonds are for 20 years at 5 per cent. A mortgage for $1,000,000 given a few months ago was cancelled.

THE BELL TELEPHONE COMPANY OF CANADA has increased its capital stock from $5,000,000 to $6,000,000, and each stockholder of record of May 23 can subscribe for the new stock at $125 per share on the basis of one share of new stock for every five shares held. Subscriptions will be payable in $25 installments every three months, beginning July 2, 1902.

PROVIDENCE TRACTION DEAL.—The terms under which the United Improvement Company of Philadelphia will take over the United Traction Company of this city have been given out. The local company has a capital of $8,000,000, all common stock, and when it was incorporated, nine years ago, was bonded for $8,000,000 more. The Philadelphia capitalists have had organized in this State a company with the nominal capital of $2,000,000, to take over such Rhode Island properties as it may buy. This concern has been called the Rhode Island Company, but it is reported that still another company is to be chartered in another State for the purpose of taking over the Rhode Island company. The announcement to the United Traction stockholders is that the Rhode Island company will guarantee 5 per cent. on the Traction Company's stock, and in addition will give one share of its own stock for every four shares of Traction stock. The offer will be accepted, as it is a good bargain for the Traction stockholders, most of whom bought their stock at very low figures. The stock at present pays 4 per cent., and is quoted at 121. United States Senator Nelson H. Aldrich is the president of the local road, and he has seen his heavy holdings grow in nine years from nothing to a premium above par. Anthony N. Brady, Hugh J. Grant and several other New Yorkers made a lot of money in the original purchase of the road from the horse-car owners. In addition to the Traction Company, the Philadelphia men are to take over and include in their Rhode Island Company the Providence Gas Company and the Narragansett Electric Lighting Company. The gas company is owned largely by Goddard interests, and pays 8 per cent. on $50 par value stock. Both companies will come in under a dividend guaranteed.

GENERAL ELECTRIC-SPRAGUE CONSOLIDATION.—Stockholders of the Sprague Electric Company have received circulars from President Markle of that company, informing them of an offer of the General Electric Company to acquire their stock. It is understood that a sufficient number of stockholders have already accepted the offer, so that the acquisition of control by the General Electric Company is assured. Under the terms of the offer the Sprague bondholders will receive 55 per cent. in Otis Elevator preferred stock and 45 per cent. in cash. Sprague preferred stockholders will receive General Electric 3½ debenture bonds, one bond for each share. Common stockholders will get 41.9 per cent. in Otis Elevator common and 20.42 per cent. in General Electric forty-year gold debenture bonds. The circular explains that the reason why Otis Elevator stock appears in the exchange is that some years ago the Sprague Electric Company sold its elevator business to the Otis Company, for which it received Otis stock. This stock has since been in the treasury, so what amounts to a distribution of the treasury assets will take place before the actual absorption is completed. The capital stock of the Sprague Electric Company is $5,000,000. That of the General Electric was recently increased to $45,000,000. Fuller details have been collected and given elsewhere in this issue.

PHILADELPHIA TROLLEYS.—With the affixing of the signatures of John B. Parsons, president, and J. B. Selfridge, secretary, of the Union Traction Company, and W. T. C. Sanders, president, and J. Edward Ryan, secretary, of the Philadelphia Rapid Transit Company, on May 24, the lease of all of the trolley lines in Philadelphia operated heretofore by the Union Traction Company passed to the new corporation, controlled by the Mack syndicate. The document transfers to the new concern the largest street railway system in the world, comprising a trackage of over 480 miles. The lease goes into effect July 1, and by that time, it is asserted, everything will be in readiness for the rapid transit company to take over the property and operate it. Prior to the execution of the lease John M. Mack was elected director of the Union Traction Company to fill the vacancy made by the resignation of Thomas Dolan. The Rapid Transit Company will organize this week. The slate for Board of Directors follows: John B. Parsons, P. A. B. Widener, William L. Elkins, George D. Widener, John M. Mack, Michael Murphy, W. H. Shelmerdin, and J. J. Sullivan. Mr. Parsons is to be the president of the Rapid Transit Company.

NORFOLK, VA., TROLLEYS.—The report is current, as already noted, that Mr. G. R. Webb, vice-president of the United Railways of Baltimore, is to become president of the Norfolk, Newport News and Portsmouth Company, which is the $9,000,000 consolidation of the street railway and kindred interests of Norfolk and neighborhood, financed by Baltimore capital. It is understood in financial circles that this official slate has been agreed upon: president, R. Lancaster Williams, Richmond, now president of the Norfolk Railway and Light Company, one of the constituent companies; vice-president, W. J. Payne, Newport News, now president of the Newport News and Old Point Railway and Electric Company, also included in the deal. General manager, E. C. Hathaway, Baltimore, now general manager of the Railways and Light Company of America, which owned the Berkeley property included in the consolidation.

MASSACHUSETTS ELECTRIC.—The trustees of the Massachusetts Electric Co. are asking permission for the issue of $5,500,000, par value, of new preferred stock. They say that all the proceeds will be invested in the securities of the companies in which the Massachusetts Electric Co. is already a shareholder, and will be applied to the carrying out of improvements.

GENERAL ELECTRIC AND COPPER.—An official of the Greene Consolidated Copper Co. says: "Reports to the effect that a controlling interest in the Greene Consolidated Copper Co. is now in the hands of the General Electric Co. are without foundation." The rumors are also denied as absurd by the General Electric Co.

Commercial Intelligence.

THE WEEK IN TRADE.—The only unfavorable feature in trade conditions during the past week was the continued unrest of labor and the idleness of large numbers of industrial workers as a result. The coal strike is the serious element of disturbance in the domain of manufacturing and industry generally, which naturally depends upon coal for its basic force, involving a loss of $1,500,000. weekly in wages to the miners and allied industrial operatives. In all other lines favorable reports have been received by the mercantile agencies. Hardware is active and lumber is meeting with unprecedented sales. Cleveland advices are to the effect that iron and steel mills are running at high tension and are sold far ahead; Pittsburg reports little let-up in the crush of demand in the iron mills; structural mills are crowded with orders, and the bar and bolt mills have all they can do. Railway gross earnings continue in a very satisfactory condition. The roads thus far reporting for the first half of the year show earnings of 8.9 per cent. in excess of the figures for the same period last year. The business failures for the week, as reported by Bradstreet's, aggregated 152 as against 190 the week previous and 192 the same week last year. The copper market continues firm, a good business being reported both for domestic consumption and for export, and prices show a further improvement. The closing quotations are 12½ c. for Lake, 12⅛ c. for electrolytic in cakes, wire bars and ingots, 12 c. in cathodes and 12⅛ c. for casting copper.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended May 17: Antwerp—19 pkgs. material, $1,321. Argentine Republic—81 pkgs. material, $1,761; 3 pkgs. machinery, $212. Brazil—166 pkgs. material, $3,594; 33 pkgs. machinery, $5,754. British Australia—342 pkgs. material, $16,979; 5 pkgs. machinery, $561. Bremen—8 pkgs. material, $304. British East Indies—25 pkgs. material, $919. British West Indies—69 pkgs. material, $2,625; 18 pkgs. machinery, $844. Chili—8 pkgs. material, $113; 1 pkg. machinery, $22. Christiania—3 pkgs. machinery, $119. Central America—19 pkgs. material, $195; 15 pkgs. machinery, $784. Colchester—2 pkgs. material, $53. Copenhagen—4 pkgs. machinery, $2,931. Cuba—13 pkgs. machinery, $2,666; 132 pkgs. material, $9,969. Gothenburg—4 pkgs. machinery, $700. Gijon—3 pkgs. material, $50. Genoa—7 pkgs. material, $334. Glasgow— 12 pkgs. material, $374; 57 pkgs. machinery, $10,586. Hamburg—10 pkgs. machinery, $495; 8 pkgs. material, $386. Havre—5 pkgs. machinery, $483; 24 pkgs. material, $385. Japan—7 pkgs. material, $475. London—331 pkgs. machinery, $5,092; 101 pkgs. material, $3,939. Liverpool—68 pkgs. machinery, $6,719; 37 pkgs. material, $1,331. Lisbon—6 pkgs. material, $545. Mexico—75 pkgs. material, $2,414; 53 pkgs. machinery, $800. Manchester—203 pkgs. machinery, $32,391; 4 pkgs. material, $1,005. Peru—5 pkgs. material, $150. St. Petersburg—1 pkg. machinery, $75. Southampton—12 pkgs. material, $971; 4 pkgs. machinery, $800. Siam—1 pkg. material, $45. Tasmania—6 pkgs. material, $175. U. S. Colombia—4 pkgs. material, $171. Vienna—2 pkgs. machinery, $1,000. Viborg—13 pkgs. machinery, $3,000.

STANTON ON COPPER.—Expert opinion in respect to copper trade conditions is that improvement will from now on be the order. Perhaps the most significant statement of an authority along these lines is this succinct one of John Stanton, quoted by the *New York Times*, as follows: "There is every reason to believe that the price of refined copper will go considerably higher. Consumption is very heavy, and production has not increased to any appreciable extent. Much of the large surplus, which was held in this conutry six months ago, has been shipped abroad. The mills are working to their utmost capacity, and many consumers are anxious to know where the supply is coming from, if consumption and production continue in the present ratio."

BIG BULLOCK ORDER.—The Pittsburg Reduction Co.'s projected works at Massena, N. Y., are to be equipped with four 1800 kw generators to be manufactured by the Bullock Electric Manufacturing Company.

THE BRADLEY MANUFACTURING COMPANY, of Pittsburg, which concern have acquired the American rights for the manufacture of the Willans central valve engine built at Rugby, England, by Willans & Robinson, Limited, have let contracts for the electrical equipment of its works now under construction at Allegheny, Pa. All the machinery will be operated by electricity. The water tube boilers are to be furnished by the Oil City Boiler Works of Oil City, Pa. The generators and dynamos will be of Bullock manufacture. Pawling & Harnischfeger, of Chicago, will install a six-ton electric traveling crane. The machine shop equipment has been ordered from the Brown & Zortman Machinery Company, of Pittsburg, Pa. The Bradley works will cover an area of 100 feet by 380 feet and are to consist of a main building, erecting shop, pattern shop, storage house, engine and boiler room, etc. They are of steel structure after designs by Samuel Discher & Sons, Pittsburg. It is the intention of the company to build engines from 50-hp up to 100. The Willans central valve engines are single acting vertical and are made either simple, compound or triple expansion. The piston rod is hollow and contains the valves which are of piston type, all mounted upon one rod, which is operated by an eccentric mounted on a crank pin. The steam enters the hollow piston rod and is admitted to the first cylinder by the movement of the rod and valves and exhausts through the piston rod into the next cylinder. In place of the ordinary crosshead and guides, there is a guide piston; on the upstroke of the engine, air is compressed in the space above this piston and the bottom of the low-pressure cylinder, and thus the pressure in the bearings is never reversed. The work done in compressing the air on the return stroke is nearly all given out again in the next working stroke, so there is practically no loss. The speed is controlled by a shaft governor operating a throttle valve. All working parts of the engine are enclosed. The principal parties interested in the enterprise are C. H. Bradley, Jr., J. H. Bailey, both of Pittsburg, and D. J. Geary of the Oil City Boiler Works, Oil City, Pa.

MORE ELECTRICAL EQUIPMENT FOR MACY.—R. H. Macy & Company's new store now being constructed at 34th and 35th Streets and Broadway, besides having the largest private lighting plant in New York—particulars of which appeared in our issue of Jan. 18—is to be equipped with one of the most elaborate pneumatic cash carrying and package handling systems, which will be operated by electric motors to be furnished by the C. & C. Electric Company, of special make. The equipment will be furnished by the Pearsall Pneumatic Tube Company, of 52 Broadway. The three blowers will be each driven by 100-hp motors. The New Jersey Foundry & Machine Co., whose offices have been removed to 9-15 Murray Street, is to supply the specially designed package conveying apparatus which will be operated by 245 low-speed motors of 2-hp each and three 5-hp ones. A 30-hp vertical motor will be furnished for driving the water supply pump and two C. & C. 7½ motors are to be used for working the laundry machinery, which is to be installed in the building.

THE CLARK AUTOMATIC TELEPHONE SWITCHBOARD CO., Providence, R. I., in addition to several recent large installations which they have recently made of their system in this country, have arranged with the Sturtevant Engineering Co., Ltd., Great Britain, to represent them in British South Africa and in Continental Europe outside of Holland, the Dutch Colonies and Belgium. In the latter countries an agency is already established and has been for some little time. The instruments already shipped abroad have given such perfect satisfaction and have rendered such splendid service that a large amount of inquiry has developed concerning them, and the new agency thus formed in connection with the existing one gives the Clark Co. an excellent opportunity of meeting the demand which the value of the system has created. Arrangements have also been made for representation in Australia. Mr. J. L. Putnam, manager of the company, passed through New York recently on a trip west, where the demand for a good intercommunicating system and inquiry in regard to the Clark system specifically has demanded attention.

SOME RAPID TRANSIT CONTRACTS.—The American Bridge Company, of New York, has been awarded the contract for the structural steel to be employed in the construction of the N. Y. rapid transit railroad's power house. The contract calls for some 9,000 tons of steel. The contract for the foundation work of the power station and for the underground condensing water conduits has been placed with Ryan & Parker, of New York. Westinghouse, Church, Kerr & Company have taken an order for two 400-hp exciter engines. The important contract for the generators is expected to be decided upon within the next few days. It will be recalled that the main engines are to be built by the Allis-Chalmers Company.

THE WILLARD STORAGE BATTERY COMPANY, of Cleveland, O., has recently been incorporated under the laws of West Virginia with $250,000 capital stock, fully paid in. The company has organized with Edmund Masson, President; J. A. Richmond, secretary-treasurer, and T. A. Willard, general manager. The company will continue the manufacture of all types of Willard battery. Considerable new machinery has been installed in the factory and new processes have been developed which will improve the plates, rendering the more uniform and in other ways increasing the life of the battery. The work will have the personal supervision of Mr. Willard.

PULLMAN TROLLEY CARS IN RUSSIA.—U. S. Consul Samuel Smith reports from Moscow, as follows: The City Electric Railroad Company, of Kief, has lately received two Pullman cars, which were ordered by the municipality as an experiment. The cars were shipped from Berlin in separate parts and are now being put together at the Kief City Railroad Works. They are of the double-truck type and have four motors of 25-hp each. The cars at present in use at Kief have two motors of 25-hp each. The new cars are equipped with all the latest improvements, including electric brakes and electric lights.

THE ALBERGER CONDENSER COMPANY, of 95 Liberty Street, New York, has recently received an order for an important condensing equipment to be installed in the steam turbine testing room of the new shops of the Westinghouse Machine Company at East Pittsburg. This apparatus consists of an 8000 sq. ft. surface condenser of the Alberger high vacuum type, a Corliss two-stage dry vacuum pump and a centrifugal circulating pump connected to a Westinghouse engine. Owing to the high vacuum desired in steam turbine practice, this condensing outfit is to maintain 28 inches of vacuum.

HANDLING HIGH TENSION CURRENT.—A number of interesting tests of high tension switches have been made at the Colgate power house of the Bay Counties Power Co. at different times. The switch designed by J. N. Kelman, superintendent of the Colgate Division, which stood the most severe test at 4,000 volts, was recently given the same severe test at 60,000 volts and handled this extremely high potential in an exceedingly satisfactory manner proving beyond a doubt that the highest potentials can be safely manipulated and controlled.

THE RENO INCLINED ELEVATOR CO. of 551 West 35th Street, New York City, has requisitioned for four special slow-speed motors varying from 7½ hp to 15 hp. They will be utilized for operating inclined stairways at the Woman's Hotel now under construction in New York uptown, and at the Siegel-Cooper store, Sixth Avenue. The C. & C. Company has also received a contract from the Standard Steel Works, Burnham, Pa., for seven 50-hp slow-speed motors for driving various machinery.

MORE MACHINE TOOLS FOR JAPAN.—Further contracts placed by F.W. Horne, of Yokohama, who it will be recalled is now in the United States and makes his headquarters at 35 South William Street with W. J. Kingsland, include several machine tools for installation, principally in Japanese dockyards and railway shops. The Bradford Machine Tool Company, the Sebastian Lathe Company, Smith & Mills, and the Bickford Drill & Tool Company, all of Cincinnati, O., have been alloted the major portion of the orders.

TROLLEY POLES FOR JAPAN.—The National Tube Company, from its Morris-Tasker, Philadelphia, works is about to make shipment of 1,000 trolley poles for the Tokio Densha Tetsudo Kabushiki Kwaisha, which concern is about to construct a 22-mile electric traction system in Tokio, Japan, the contract for the equipment of which was recently secured by the General Electric Company through the Japanese house of Mitsui & Company, which is financing the enterprise.

VARIOUS C. & C. ORDERS.—The C. & C. Electric Company has been allotted an order by the Grasselli Chemical Company, East Chicago, Ill., calling for a 150-kw belted generator, switchboard, etc., and two motors of 25-hp capacity each. This equipment will be used for operating machinery in the Chicago Works. The John G. Woodward Company, of Council Bluffs, Iowa, has ordered a 75-kw direct connected generator for lighting purposes.

BRILL TRUCKS FOR ADELAIDE.—Brill trucks will be utilized on the projected electric traction system in the city of Adelaide, South Australia, the contract for the equipment of which, as mentioned in these columns last week, has been secured by the Australian electrical engineering and contracting firm of Noyes Brothers, of Sydney, on behalf of the Westinghouse interests. In the first instance at least 150 cars will be operated.

MACHADO & ROLLER, 203 Broadway, New York, have taken over the exclusive manufacturing and selling rights for the ohmmeters formerly made by F. B. Sage & Co. These devices will now be manufactured by the Whitney Instrument Company, for whom Machado & Roller are the general selling agents, and the new facilities will, it is understood, permit a reduction in price.

General News.

THE TELEPHONE.

GOODWATER, ALA.—The Bell Telephone Company has recently installed a telephone exchange here.

NEW DECATUR, ALA.—The William J. & Frank E. Bell Telephone Company, of Chicago, Ill., is making arrangements to establish a system in this place to compete with the Southern Bell Company. They agree to furnish telephones at less than half the rates charged by the latter.

DOVER, DEL.—The International Telephone Company of America surrendered its corporate franchises and filed a certificate of reincorporation. The incorporators are Josiah Marvel, Edward Marvel and William M. Lupton, all of Wilmington, Del.; capital, $1,000,000.

COVINGTON, KY.—The Citizens' Telephone Company has increased its capital stock from $30,000 to $100,000.

SALT LICK, KY.—The Salt Lick & Yale Telephone Company has been incorporated with W. J. Fell, president; J. H. Campbell, vice-president; A. H. Points, treasurer. The above, with W. A. Whitcomb, N. R. Ratliff and Sherman Gullett, are directors.

COUNCIL, IDAHO.—A stock company is being formed to build a telephone line from Meadows to Council. Frank Gribben is interested.

DUNCAN, ILL.—The Duncan Telephone Company is extending its line to Princeville.

TUSCOLA, ILL.—The Coles County Telephone Company has applied for a franchise to enter this city.

COOKSVILLE, ILL.—The Cooksville Telephone Company has incorporated with a capital of $8,000. Jos. Arnold is one of the incorporators.

WATERLOO, ILL.—The Harrison Telephone Co. of Waterloo, Ill., has petitioned for a franchise to connect Waterloo and Millstadt by telephone.

CARBONDALE ILL.—The Carbondale Telephone Co. of Carbondale has been incorporated with a capital stock of $5,000. The incorporators are Joseph B. Bundy, Daniel B. Parkinson and Daniel M. Parkinson.

CARLINVILLE, ILL.—Representatives of the Macoupin Telephone Co. and the Chesterfield Telephone Co. held a meeting recently at which an agreement was reached regarding a new telephone line from this city to Chesterfield. The Chesterfield people will construct a line from that village to Comer, and the Macoupin Co. of this city will build from this city to Comer, making a direct toll line. The Chesterfield people will also construct two lines to Medora, one for toll business and one for the farmers along the route. When the three lines are completed they will have connection with the Kinloch system of St. Louis, giving them a long distance line into that city.

GAS CITY, IND.—The council has passed an ordinance over Mayor Lay's veto, granting the United Telephone Company, of Marion, a franchise to use the streets, erect a system and put in an exchange.

CLARKS HILL, IND.—Eighteen co-operative telephone companies in the northern district of the farmers' telephone system are considering negotiations looking to connection with Lafayette and Lebanon, and for better and more permanent connections with Frankfort, Crawfordsville and other cities.

MUNCIE, IND.—The organization of the Delaware-Madison County Telephone Company has been completed, the $500,000 stock being quickly taken. The new company has begun operation in this city. When the system is completed 140,000 telephones will be connected—65,000 in Indiana and 75,000 in Ohio.

FLORA, IND.—Local business men and neighboring farmers have organized the Farmers' Mutual Telephone Company, with a capital of $25,000. The Flora & Bringhurst Telephone Company has been in operation here for three years, but the service is unsatisfactory, and this movement is for self-protection and for lower rates. The old company is desirous of selling to the new.

LAFAYETTE, IND.—The telephone girls of the Lafayette Telephone Company went out on a strike recently and tied up the service for several hours, thereby forcing an answer to their demand for a raise to 10 cents an hour. Compromise terms were finally agreed to, whereby the girls get 9 cents an hour and the company signed an agreement not to discharge anyone for participation in the strike.

MARION, IND.—The Central Union Telephone Company has embarked in the grocery business in this city. The company is taking orders from all subscribers having telephones in their houses, and is delivering groceries at cost. The move is the result of a boycott made against the company by the leading groceries. The company announces that if the boycott is continued it will establish the largest general store in the city.

EVANSVILLE, IND.—Mayor Covert has appointed a committee and started it out to solicit subscriptions for stock to the municipal telephone company which he is promoting. The franchise will not be presented to the board of public works until after enough stock has been sold to insure the completion of the plant. The people do not seem so enthusiastic over the scheme since realizing that they are expected to pay for the enterprise.

INDIANAPOLIS, IND.—The following telephone companies have been organized recently: The Baldwin Telephone Company. Capital stock $4,800, to operate in Montgomery County. The Modoc Telephone Company, of Modoc, capital stock $5,000. Directors, T. F. Whellan, H. A. Gaddis, P. E. Stepanek and R. H. Hunt. The Moncrief Telephone Company, of Moncrief. Capital $1,000. Walter Boyd heads the board of directors.

INDIANAPOLIS, IND.—The directors of the New Castle Telephone Company have filed amended articles of incorporation. The company proposes to extend branches through the counties of Henry, Delaware, Madison, Rush, Hancock and Wayne. R. R. Faulkner has purchased a controlling interest in this company and as he is interested in several independent companies it is believed the system will now be largely extended. This company came into existence through the raising of prices by the Central Union.

DENISON, IOWA.—A special election will be held June 10 to vote on a franchise for the Crawford County Telephone Exchange.

DAVENPORT, IOWA.—It is probable that the Iowa Telephone Company will extend a line from this city to Plainview and Maysville.

CUSHING, IOWA.—The Farmers' Telephone Company, of Cushing, has incorporated with a capital stock of $6,000. G. A. Dowell is president.

MARYSVILLE, KAN.—The Marysville Telephone Company has incorporated with a capital of $10,000.

RUSSELL SPRINGS, KAN.—The Logan County Telephone Company has incorporated with a capital of $2,500.

RAYVILLE, LA.—The Cumberland Telephone Company will extend its line from Girard to this place.

PONTIAC, MICH.—The Union Telephone Company is building a line from Linden to Holly.

DETROIT, MICH.—The Michigan Telephone Company will extend its lines to Mass City, Greenland and other points in Ontonagon County.

VERNDALE, MINN.—The Central Telephone Company, of Verndale, Minn., has been incorporated; capital, $10,000; incorporators, S. L. Frazier, George E. Merrill, Wilbur N. Morrill, H. M. Henderson, of Wadena, and James Boyd, Alexander Boyd and Peter Boyd, of Central, Minn.

WEST POINT, MISS.—The Citizens' Long Distance Telephone & Telegraph Company is installing a system here.

SOUTH OMAHA, NEB.—The South Omaha Independent Telephone Company has incorporated with a capital of $75,000. W. S. King is interested.

FRANKLIN, N. H.—The Citizens' Telephone Company will construct a line towards Sanbornton.

IVY, N. C.—The Ivy Telephone Company has ordered material for 50 miles of line.

BEAUFORT, N. C.—Mr. R. A. Strong of this place has completed arrangements for a new telephone system by which subscribers can have instruments metallic line to Lincolnton and the cotton mills on the C. & N. W. Railway.

GREENSBORO, N. C.—The Southern Bell Telephone & Telegraph Company has made application for a franchise for a local exchange in this place.

NAPLES, N. Y.—The Naples Telephone Exchange, of Naples, Ontario County, capital $8,000, has been incorporated; directors, S. A. Story, H. W. Blake and G. B. Hemenway, of Naples.

ALBANY, N. Y.—The Coxsackie & Greenville Telephone Company, of Medway, Greene County, has been incorporated with a capital of $995. The directors are W. S. Rundall and James Stevens, of Greenville; G. B. Lampman, D. E. Davis, Spencer Palmer and W. N. Miller, of Medway; William T. Haswell, of Climax; Levi Bedell, of Coxsackie, and Joseph A. Losee, of Grapeville.

STRYKER, OHIO.—The Stryker Rural Telephone Company is reorganizing, and will build a farmers' community system.

MT. BLANCHARD, OHIO.—The Peoples' Telephone Company, of Hancock county, has been incorporated with $25,000 to build a local system.

PORT CLINTON, OHIO.—The Port Clinton Telephone Company will build a third line to Lacarne to accommodate the increasing patronage among farmers in that section.

MILLBURY, OHIO.—The Millbury Telephone Company has been incorporated with $5,000 capital stock by Fred Calkins, F. F. Ohmstead, H. J. Middough, L. T. Williams and M. L. Barmer.

HAMILTON, OHIO.—Judge Belden has refused the application of the Bell Telephone Company for an injunction restraining the Hamilton Home Telephone Company from building its system.

CHILLICOTHE, OHIO.—The Chillicothe Home Telephone Company has organized as follows: Joseph S. McKell, president; William A. Wayland, vice-president; Louis Brehmer, treasurer; Charles Duncan, secretary.

BATAVIA, OHIO.—The Citizens' Telephone Company has established an exchange and is building lines to Manila, Belfast, Newton, Cozadale and Goshen. Free service will be given throughout Clermont county.

MONROEVILLE, OHIO.—The Huron County Telephone Company has been sold by C. R. Callaghan, F. A. Knapp, W. M. Halliday and others to Hon. J. F. Laning, of Norwalk. The property includes exchanges at Monroeville, Chicago Junction, Plymouth and New Washington. The price paid was about $70,000. Mr. Laning is at the head of the proposed Local Telephone Company, which is endeavoring to consolidate exchanges in Huron, Erie, Crawford and Seneca counties. He holds options on exchanges at New London, Greenwich, Milan, Berlin Heights, Crestline and Attica.

COLUMBIA, S. C.—The South Carolina Long Distance Telephone Company has completed a line to Camden and will push on to Hartsville, a distance of 30 miles. The line to Augusta, Ga., will probably be completed within a month.

CENTERVILLE, TENN.—Mr. I. B. Parker of this place is endeavoring to establish a new independent telephone system. His plans are favored by a number of the citizens.

BON AIR, TENN.—The Gainsboro Telephone Company will in the near future build a line from this place to Ravens Croft, where the new shaft mine of the Bon Air Coal Company is being opened.

SALT LAKE CITY, UTAH.—A long distance telephone system is now in successful operation from Nome as far as Soloman City, below Port Safety. It is understood the Long Distance Telephone Co. will extend its line to all of the different mining districts, or wherever business will warrant. Telephones have been installed at Nome River, Hastings Creek, Port Safety and Soloman City.

SALT LAKE CITY, UTAH.—The Inland Telephone & Telegraph Co. is making improvements in the local system at North Yakima, Wash., and the 40-mile gap between Pasco and Prosser will be at once closed. When this line is completed it will open up eastern Oregon, eastern Washington and parts of Idaho. A new loop will also be built over the Cascade range at Stampede pass, so as to give better service.

ALEXANDRIA, VA.—The English Telephone Company has been chartered. L. Hutchins is interested.

FREDERICKSBURG, VA.—The stockholders of the Upper Rappahannock Telephone Company have organized, with Robt. Beverley, of Essex, president. The line will be built at once.

CUMBERLAND C. H., VA.—The Fluvanna and James River Valley Telephone Company has extended its lines to Cumberland, and communication will soon be established with Richmond. The next extension, it is said, will be to Farmville. A number of farmers along the route are taking the service

CLARKSBURG, W. VA.—The Sardis Telephone Company has incorporated with a capital stock of $10,000. H. A. Swiger is interested.

MILWAUKEE, WIS.—The Wausaukee Telephone Company has incorporated to operate in Marinette County; capital, $10,000. E. F. Fox is interested.

ELECTRIC LIGHT AND POWER.

TALLADEGA, ALA.—The Talladega Company, of Talladega, has petitioned the city for a franchise to operate a light, power and traction system. The capital of the company is $600,000.

LOS ANGELES, CALIF.—The Consumers Electric & Gas Company, of Los Angeles, will attempt to secure a franchise and conduct a branch business in Santa Ana, Calif.

SAN FRANCISCO, CALIF.—The Dillon Electric & Power Company which recently bought the electric plant of the Orr Electric & Power Company, at Dillon, Mont., will improve and extend the system.

SAN FRANCISCO, CALIF.—The Terminal Gas, Electric & Power Company has been incorporated by F. H. Rindge, H. C. Carter and other Los Angeles capitalists. Electric light and power will be supplied in San Pedro, Calif.

SAN FRANCISCO, CALIF.—The General Electric Company has closed a contract to furnish a 500-hp induction motor for the Pacific Coast Smelting & Refining Works. The plant is situated at Bay Point, Contra Costa County, Calif.

SAN FRANCISCO, CALIF.—The Northern California Power Company was the successful bidder for the Glenn County franchise for which it had applied. The company will transmit electric power from its plant on Mill Seat Creek near Shingletown through five counties. The town of Willows will be reached under the new franchise.

SAN FRANCISCO, CALIF.—The great dome of the City Hall in San Francisco will be elaborately wired for 5,000 sixteen-candle power electric lights. The Board of Supervisors has appropriated $3,500 for that purpose. The illumination of the dome has been a great feature on several occasions and the permanent installation will show a great improvement over the temporary effects.

SAN FRANCISCO, CALIF.—The Santa Paula Electric Light Company, which was recently incorporated with a capital stock of $200,000, will install an electric plant within 60 days to furnish current for lighting in Santa Paula, Calif. The directors are J. A. Driffel, of Oxnard, C. C. Teague, of Santa Paula, and W. J. Wayte, of San Francisco. Construction work has been commenced.

SAN FRANCISCO, CALIF.—The United Gas & Electric Company of San Francisco has almost completed its plans for the final transfer of the properties of the three electric companies carrying on business in and around San Jose, Calif. As soon as possible the works of the San Jose Light & Power Company will be shut down and the electric plants of all of the companies concentrated at the Electric Improvement Company's new plant in San Jose. A large central station and sub-station will be established for generating current when necessary and for distributing the current of the Standard Electric Company. All of the towns on the west side of San Francisco Bay will be lighted from the Standard Company's transmission lines. The local power houses in the towns between San Francisco and San Jose will be abandoned and both electricity and gas will be distributed from San Jose.

SAN FRANCISCO, CALIF.—The California Central Gas & Electric Company, San Francisco, which is the distributing company for the Bay Counties Power Company recently held its annual meeting and re-elected its directors and officers. John Martin is president of the corporation, John A. Britton, vice-president, and F. H. Pierson, secretary. The gross receipts for the past 10 months were $255,168.85, and the net surplus is $26,770.10. The company's assets include the gas and electric plants in Chico, Marysville, Woodland, Colusa, Grass Valley, Nevada City, Napa, Santa Rosa, Petaluma and San Rafael. The bond issue amounts to $1,000,000, bearing 5 per cent. interest. An allied company, the California Gas & Electric Corporation, holds an option on the Oakland Gas, Light & Heat Company. The Oakland plant would be very important as a reserve steam plant in case of interruption of the current from the Bay Counties' system.

LAKE CITY, COLO.—The Tobasco Mining Company, of Lake City, will install a complete electric equipment, including hoist, pumps, and drills.

DENVER, COLO.—Col. J. B. Frank, of Denver, who controls the electric light plant at Alamosa, Colo., will rebuild the present plant to twice its capacity.

WILMINGTON, DEL.—The General Electric Company will construct the plant of the Cape Fear River Company at Buckhorn Falls. Already about $250,000 has been expended. An examination has been made of sites for a power plant near Fayetteville, N. C.

EISER, IDAHO.—The city council has granted to H. V. Gates, of Hillsboro, Ore., a franchise to install an electric lighting plant. The city is to own the plant, giving Mr. Gates a lease for 15 years at $1.00 per year rental. The city will vote $25,000 in bonds for the plant.

VENICE, ILL.—A new 300-hp engine is to be added to the present equipment of the Venice Light & Power Co.

ALTON, ILL.—The "Big Four" railroad will establish an electric plant near its new station in East Alton, and all railway switches will be operated by electric power.

BOSWELL, IND.—The Boswell Electric Light & Water Company has been incorporated with a capital of $25,000. The incorporators are P. J. Shaw and B. H. Bennett.

NEW ALBANY, IND.—Chicago capitalists, represented by John Tevis of Louisville, have purchased the property of the local light, heat and power company, the consideration being $147,000.

EVANSVILLE, IND.—The People's Light, Heat and Power Company of this city has incorporated with a capital stock of $25,000. The directors are William F. White, Charles W. Wetmore, A. B. Vohus and C. C. Bragg.

INDIANAPOLIS, IND.—The Board of Public Works has decided to grant no more franchises to small companies to lay conduits in the downtown streets for electric light and power purposes. Only large companies, such as are capable of bidding for the city lighting, will be granted franchises.

EVANSVILLE, IND.—C. H. Roberts and Deputy City Treasurer Geo. P. Heilman, are promoting a stock company to build and operate electric plants for the propulsion of farm machinery and implements, gang-plows, etc. Roberts has patents covering his scheme. The headquarters and machinery factory will be situated at Evansville.

NEW ALBANY, IND.—The United Gas and Electric Company, of New Albany and Jeffersonville, has been incorporated with $1,000,000 capital stock. The company is empowered to merge the existing companies by exchange of stock. The incorporators are: Samuel Insull, Chicago; W. B. Hummer, La Salle, Ill.; Rob't W. Waite, New Albany; John Tevis, Louisville, and Jno. W. Dunbar, New Albany.

RAYNE, LA.—Negotiable bonds to the amount of $20,000 have been voted for the construction of a system of waterworks and electric lights.

HOMER, LA.—A proposition will be put before the voters of Homer to allow the town council to issue $10,000 in negotiable bonds to build and equip an electric light plant.

FALL RIVER, MASS.—Electric power is being installed for the driving of the machines in the three new buildings of the Stevens Manufacturing Company in this city. A new generator, direct connected to a 1,100 hp. McIntosh & Seymour engine, will supply the power, which will be distributed to the motors in the various buildings. The largest motors will have a capacity of 150 hp, and the machines will be belted to shafting.

ST. LOUIS, MO.—Articles of incorporation of the West St. Louis Water and Light Co. with a capital stock of $80,000, all paid, have been filed. Among the shareholders are Edward S. Lewis, S. M. Phelan, Thomas W. Crouch, Paul A. Fuez, and Edgar D. Tilton.

ST. LOUIS, MO.—The City Lighting Co. has filed a fee deed transferring all its property to the Imperial Electric Light, Heat & Power Co. The capital stock of the City Lighting Co. is $600,000 and of the Imperial Company $1,500,000. The transfer was effected for the better handling of the affairs of the two companies.

PORTSMOUTH, N. H.—A 22-ton generator has been installed in the Rockingham County Electric Light & Power station. Seventeen horses were required to draw the load from the railroad station to the new plant.

TROY, N. Y.—The Greenwich Co-operative Electric Company has been formed to utilize the water-power at the old cider mill at Sprague town, and furnish power and light to the farmers in the vicinity.

SYRACUSE, N. Y.—The Syracuse Lighting Co. has bought a corner lot at East Syracuse upon which will be erected a sub-station for the purpose of lighting East Syracuse and Eastwood Heights.

ALBANY, N. Y.—The Kingston Gas & Electric Company, of Kingston, has been incorporated with a capital of $70,000, to furnish gas and electricity in Kingston and the towns of Ulster county. The directors are Morris W. Stroud, R. L. Babcock, of Philadelphia, and Franklin J. Tobey, Eugene W. Prout and Jeremiah P. Osterhondt, of Kingston.

LAURINBURG, N. C.—At the recent election the proposition to issue $30,000 bonds for water and electric light plant was carried.

MAXTON, N. C.—A certificate of dissolution of the Maxton Light and Power Company has been filed with the Secretary of State.

RALEIGH, N. C.—The Raleigh Electric Company was awarded the contract for 155 enclosed arc lights at $55.75 per lamp per year. Competition gave the city an advantage of about $19 per lamp.

NEWBERN, N. C.—The new electric plant of the city of Newbern has been completed. It has a capacity of 100 arc and 2,000 incandescent lights, and the town is now lighted after ten months of darkness.

BREVARD, N. C.—Julian D'Este, of Boston, has examined the water powers of this section with a view to purchasing. His plan, it is said, is to develop the water powers and then sell to parties desiring to start industrial enterprises, provided the sites are purchased of Mr. D'Este.

MIAMISBURG, OHIO.—The Miamisburg Water, Light and Power Company will accept the franchise for an electric light plant in the city. The company will first make an offer of $5,000 for the old municipal plant.

LAWTON, OKLA.—The Comanche Light & Power Company, of this city has been incorporated with a capital stock of $50,000. The incorporators are:

W. H. McGroager, of Wichita Falls, Tex.; W. H. Anderson, George W. Broe, F. M. English and George M. Paschal, of Lawton.

CANYON CITY, ORE.—The City Council of Canyon City has been asked to grant P. R. Riebalt a franchise for an electric light and power plant.

PORTLAND, ORE.—There is a very spirited competition in the electric light and power field tributary to Portland, Ore. F. S. Morris, of the Oregon General Electric and the Portland City & Oregon Railway Companies, was the successful bidder at an administrator's sale of 135 acres of land carrying valuable water rights on the upper waters of the Clackanas River. The price paid was $11,000, though its appraised valuation was $850. The Portland General Electric Company was the rival bidder that ran up the price.

WACO, TEX.—St. Louis capital will probably furnish a $5,000,000 water and electric light plant. Work is expected to commence within 90 days. Representatives from St. Louis are being negotiated with.

HAMPTON, VA.—The town council of Hampton has granted a franchise to the U. S. P. Shield Company, of Philadelphia, to establish an electric light and gas plant in the city. The franchise is open for only 30 days. The company accepting will also be required to deposit a bond of $10,000.

OTTAWA, ONT.—The Ontario Power Company has commenced operations on the upper section of its works at Niagara Falls, Ont., and a large force of men is now at work near Chippawa. This section of the work consists of a canal 100 feet wide and 20 feet deep, running from Welland river, in the village of Chippawa, to near the bluff above the Dufferin Islands.

MONTREAL, QUE.—The annual general meeting of the Demerara Electric Company, of British Guiana, was held a few days ago in Monreal. The company now controls the tramway and lighting business of Demerara, as the gas company has been forced to close down. The electrical plant is being extended to take up the increased business offered. All the members of the old board were re-elected: Sir William Van Horne, president; Senator Drummond, Messrs. W. B. Chapman, James Hutchison, Senator McKeen and B. F. Pearson. Mr. E. Alexander is secretary-treasurer.

THE ELECTRIC RAILWAY.

MUNCIE, IND.—The Muncie & Western Railway Company has been incorporated with $50,000 capital stock by Frank C. Ball, Edmund Ball, Lewis Clark and W. C. Ball.

RICHMOND, IND.—The contract for the construction of the Hamilton, Eaton & Richmond Traction Railway has been let to the Falk Company of Milwaukee, Wis. The figures exceed $1,000,000.

INDIANAPOLIS, IND.—The interests back of the Wabash River Transportation Company and the Logansport Street Railway Company have incorporated the Wabash-Logansport Traction Company, with $100,000 capital.

TOPEKA, KAN.—The Chanute and Iola Interurban Electric Railroad Company has been incorporated with a capital of $300,000.

NEW CASTLE, KY.—A franchise for an electric railway between New Castle and Eminence has been sold to Judge William Pryor, of Frankfort, Ky., and William Ellis, of New Castle, representing Louisville and Baltimore capitalists.

LOUISVILLE, KY.—The Louisville & Mt. Washington Railway Company (electric) has filed articles of incorporation, with $10,000 capital, with the privilege of increasing to $400,000. P. N. Clarke, of Louisville, and a number of others are interested.

AUGUSTA, ME.—The Lewiston, Winthrop & Augusta Electric Railroad has voted to change the name of the company to Augusta, Winthrop & Gardiner.

ST. LOUIS, MO.—The St. Louis & East St. Louis Electric Railway has filed notice of an increase of capital stock from $250,000 to $500,000.

GREENSBORO, N. C.—The Board of Aldermen of High Point has granted a franchise for a street car line. The charter is an ambitious one, proposing to build an electric railway to both Greensboro and Winston-Salem. B. H. Sawyer and others are interested.

SYRACUSE, N. Y.—The Syracuse Rapid Rapid Transit Railway Co. has purchased two parcels of property in Salina, to be used in connection with the building of its proposed new trolley line to Liverpool.

TIFFIN, OHIO.—J. C. Parker, promoter of the Sandusky, Clyde, Tiffin & Southern Railway, has applied for a franchise in Tiffin.

PIQUA, OHIO.—A deal has practically been completed for the lease by the Dayton & Troy Electric Railway Company of the property of the Miami Valley Railway Company.

COLUMBUS, OHIO.—The Urbana, Mechanicsburg & Columbus Railway Company has completed plans for its power house, to be built at Plain City. It will have a total capacity of 3,000 hp.

COLUMBUS, OHIO.—The Ohio Legislature has passed the Thompson bill, by which interurban electric railways will be placed on the same footing with steam roads in the matter of acquiring rights of way.

SPRINGFIELD, OHIO.—The Dayton, Springfield & Urbana Railway Company proposes to make Springfield the central point for repairs. About $100,000 will be spent in the erection of repair shops and car shops.

LIMA, OHIO.—The Lima Electric Railway & Light Company has increased its capital stock from $500,000 to $850,000. Joseph B. Mayer is president and H. L. C. Denny secretary of the company. Improvements will be made.

ZANESVILLE, OHIO.—The report is current that the Pennsylvania Railway Company will equip the Cincinnati & Muskingum Valley Railway with electricity between Zanesville and Trinway, a distance of 14 miles, and possibly the entire line.

FINDLAY, OHIO.—The Findlay, Kenton & Urbana Railway Company has organized as follows: David Joy, president; C. Thorndyke, secretary; W. J. Burket, treasurer. Directors: J. N. Shafer, M. H. Monheimer, David Joy, F. W. McClure, Edward K. Campbell, James Steen and W. J. Burket.

EAST LIVERPOOL, OHIO.—A company, promoted by B. S. Pope, S. B. Goucher, F. G. Porter, Charles Brenneman and Edward Hazlett, of this city, is planning to build a road from New Cumberland, W. Va., to this city. The Hancock county, W. Va., probate court has been asked for a franchise, and the road will be built this summer.

CANTON, OHIO.—The new power station of the Canton-Akron Railway will be larger than originally proposed, as it will furnish power for the Canton-Massillon lines and the proposed New Philadelphia line. The main building will be 131x145 feet and there will be sub-stations at Akron and Massillon. Orders for new machinery, in addition to that purchased some time ago, have been placed.

PORTSMOUTH, OHIO.—The recently incorporated Ohio Valley Traction Company has organized as follows: L. D. York, president; R. D. York, vice-president; John H. Lange, secretary; Samuel Baird, general manager. The above with Harry Miller and George Kircker constitute the board of directors. The company will build a road from Yorktown to Sciotoville. Right of way has been secured and construction work will start at once.

MASSILLON, OHIO.—The Massillon, Dalton & Wooster Street Railway Company has been organized with T. Harvey Smith, president; J. C. Putnam, vice-president; I. M. Taggert, secretary-treasurer and W. S. Goudy, general manager. Others interested are J. W. McClymonds, James Hunt, George Schultz, and Walter J. Mullins. Right of way has been secured between Massillon and Dalton and the company is asking for a franchise in Massillon.

CINCINNATI, OHIO.—The final steps have been taken for the consolidation of the Southern Ohio Traction Company, the Cincinnati Northwestern Railway Company, the Maimisburg & Germantown Traction Company and the Hamilton & Lindenwald Electric Transit Company. The consolidated company will be known as the Cincinnati, Dayton & Toledo Traction Company. The capital stock is $5,000,000 and bonds of like amount will be issued, of which $2,300,000 will be retained in the treasury to retire underlying bonds. There will be issued to retire the Southern Ohio Traction stock, $1,200,000, and there will be retained in the treasury for future extensions, consolidations, etc., $1,500,000.

CHARLESTON, S. C.—The Charleston Suburban and Summerville Railway Company has been granted a franchise in this city.

NEW INDUSTRIAL COMPANIES.

THE ELECTRIC EXPLODER COMPANY has been incorporated in Jersey City to manufacture fuses, etc.; capital, $50,000. Incorporators—Samuel Riker, Jr., Jacob Pawel and Ella Hartnett.

THE SORENSON MANUFACTURING COMPANY, of Ravenna, Ohio, has been incorporated with $25,000 capital stock by James Sorenson, E. R. Taylor and A. C. Williamson, to manufacture Rontgen-ray machines and optical instruments, the invention of Mr. Sorenson. The company now has a factory in operation.

PERSONAL.

MR. A. M. MATTICE, chief engineer of the Westinghouse Electric Manufacturing Company, has sailed for Europe on the "Campania."

MR. FRANK SHEPARD, the electric railway engineer, who has been in England attending to important franchise interests there, is again in this country for a while.

MR. C. F. SCOTT, chief engineer of the Westinghouse Electric & Manufacturing Company, has sailed for England at short notice by cable. Mrs. Scott accompanied him.

MR. JOHN L. LEWIS, the electrical contractor, of Mountain Lake Park, Md., has contracts for two central stations in hand, one at Buckhannon and one at Davis, W. Va., both to be completed by August 1.

MR. JAMES A. PIERCE, formerly representing the repair department of the Rossiter-MacGovern Company, in the East, has accepted the position of western manager for that company, with office at St. Louis.

MR. G. B. DUSENBURY, manager of the apparatus department at Pittsburgh of the Westinghouse Electric and Manufacturing Company, has been suddenly called to Europe, and left last week by Cunard steamer.

MR. C. T. THOMSON, M.I.E.E., late superintending engineer of the Brush Electrical Engineering Company, Ltd., of England, is on a trip to this country, and has been visiting various factories and plants during a brief stay.

MR. ISAAC D. PARSONS contributed to the *Engineering Magazine* in January and February an article on "The Economy of Isolated Electric Plants," giving a good deal of data. The article has now been issued in handy pamphlet form.

MR. T. A. ESTEP, president, R. D. Nuttall Co., Pittsburg, will be in attendance at the International Street Railway Convention in London, where the concern will make an exhibit at the Agricultural Hall of its gears and pinions, for which a large market has already opened up in Europe.

MR. W. G. RONEY, of stoker fame, has returned to his New York desk in the Westinghouse offices after a three months' vacation on his ranch in California, where he is growing acres of big walnuts and other nice things. Meantime a large number of contracts for power plants have come up to demand his attention.

MR. R. I. WALLIS-JONES, of London, sailed for home on May 24 on the "Campania," after visiting Boston, New York and other cities. His stay was unfortunately too short to permit him to give attention to all the important electrical business matters arising in the course of his stay.

MR. JOHN F. CALDERWOOD has been called on to occupy a position as assistant to President Jacob L. Greatsinger, of the Brooklyn Rapid Transit Company. In addition to other duties, he will have charge of the auditing department. Mr. Calderwood comes from Minneapolis, Minn., where he was connected with the Twin City Railroad Company for several years.

MR. LEONARD ANDREWS, M.I.E.E., borough electrical engineer for Hastings, England, has spent his vacation this year in the United States, studying up electrical conditions, and is only sorry it is not longer. He is a shrewd and competent observer, and has made a great many friends and acquaintances in his swift circuit around the country, including the recent electric light convention at Cincinnati.

MR. JNO. A. PILCHER has accepted a position as mechanical engineer for the Norfolk & Western Railway Company, vice Mr. Chas. A. Seley, who resigned to accept a similar position with the Rock Island Railroad. The appointment is effective May 15. Mr. Pilcher was for eight years connected with the Norfolk & Western Railway as chief draughtsman, and for the last three years he has been connected with the Baldwin Locomotive Works.

MR. BRYCE E. MORROW, assistant foreman of the Testing Department of the General Electric Company at Schnectady, N. Y., has resigned his position to take the superintendency of the Hudson River Power Company's plant to be located at Spier Falls, N. Y. Mr. Morrow is at present with the Hudson River Power Company at Mechanicville, and will remain there until the Spier Falls plant is completed. Mr. Morrow is a well known electrician and was in the employ of the General Electric Company for the past fourteen years.

Trade Notes.

DIRECT U. S. CABLE.—The early demolition of No. 40 Broadway for the purpose of erecting a modern skyscraper, made it necessary for the Direct U. S. Cable Company to seek new quarters. It is now located at 6$ New street.

KILFYRE.—Gen. C. H. Barney, of the Monarch Fire Appliance Company, 27 William street, Nek York, advises us that the highest award in its class has been given to this extinguisher, supplementing similar awards at other leading expositions.

ELECTRICAL FITTINGS FOR ST. LOUIS FAIR.—The Commercial Electrical Supply Company, St. Louis, Mo., has secured the contract to supply the electrical fittings on the St. Louis Exposition grounds. The contract amounts to $36,895.

THE CENTRAL MANUFACTURING COMPANY, Chattanooga, Tenn., lost its shops and lumber yards by fire on May 10. Preparations are already well under way toward building a new plant, and in a short time orders can be filled for pole-line material.

THE CLEVELAND ENGINEERING COMPANY, Cleveland Ohio, has opened offices at 817 New England building, and is prepared to act as general consulting engineers for electrical and steam power work, heating and ventilating. It will also make efficiency tests on existing plants.

THE BURT MFG. Co., of Akron, Ohio, reports a recent shipment of its Cross oil filters to different cities in the Far East—India, China, Japan and the Philippine Islands. Other important shipments recently made by this firm went to England, Austria, Belgium, Mexico and Argentine Republic.

MOTOR VEHICLE EQUIPMENTS.—Circular No. 1059 of the Westinghouse Electric & Manufacturing Company is devoted to electric motor vehicle equipments. Illustrations and descriptions are given of every detail of a motor vehicle equipment, including cut-out switch, battery and cable terminals, and several types of controllers.

ECONOMY OF ISOLATED PLANTS.—The Payne Engine Company, 120 Liberty Street, New York, has reprinted in pamphlet form an article by Mr. Isaac D. Parsons, on "The Economy of Isolated Electric Plants," which appeared in a recent issue of the *Engineering Magazine*. The article is an argument in favor of isolated plant over central station service.

STORAGE BATTERIES.—The United States Accumulator Company, 212 East Illinois Street, Chicago, Ill., has issued a second edition of its catalogue and price-list of storage batteries for light and power plants. The advantages of the storage battery and of its several applications are concisely set forth. One section is devoted to information as to the selection of a battery for residence lighting.

RHEOSTATS AND DIMMERS.—The Wirt Electric Company, 180 Broadway, New York, has issued a new edition of its pamphlet on rheostats, dimmers, motor controllers and brushes, which includes two-score or more illustrations and descriptions of Wirt apparatus. The rheostats are for innumerable applications, among the less common being rheostats for photometric measurements, calibration of instruments, induction coils and stereopticons.

LAUNCHES AND YACHTS.—A pamphlet of no less than 120 pages is required to set forth in illustration and text the numerous types of launches and yachts manufactured by the Electric Launch Company, Bayonne, N. J. In addition to electric launches ranging from a small fishing boat to a cabin yacht, a number of gasoline boats are shown. The final pages describe and illustrate independent charging plants for launches and for lighting residences.

MR. F. J. NEWMAN has severed his connections with the Westinghouse Electric & Mfg. Co., Pittsburg, Pa., and opened an office as consulting automobile engineer, at 504 Lewis Building, Pittsburg. Mr. Newman would be pleased to hear from carriage manufacturers contemplating going into the automobile field, and from railway and power companies having use for electric tower wagons and an electric automobile with testing apparatus for line work.

PAY STATIONS THAT PAY.—The American Toll Telephone Company, 45 Sheriff Street, Cleveland, have issued a handsome 32-page pamphlet entitled, "Pay Stations That Pay," in which concise descriptions are given of pay station apparatus, accompanied by illustrations. Among the devices illustrated and described are seven forms of coin pay stations, a call register for commercial service, a consecutive counter and a number of minor devices used in connection with pay toll stations.

LUNDELL MOTORS.—In Bulletin No. 301, of the Sprague Electric Company, New York, Lundell motors for driving ventilating fans and blowers are described and illustrated. Among the illustrations are three handsome halftones of the Capitol at Albany, N. Y., and the Congressional Library and Corcoran Art Gallery at Washington, D. C., all of which are ventilated by the aid of Lundell motors. Some useful tables, showing power required for driving air-propellers, etc., are given.

THE SAMSON CORDAGE WORKS, Boston, Mass., call attention to the fact that much of the cord used for arc lamp and trolley cord is rough, or soft, and wears out quickly by abrasion. It is especially important where the safety of a lamp is concerned to use the best obtainable cord made from strong "all cotton" or Italian hemp yarns, and having a hard smooth braid and smooth finish, preferably waterproofed. They are always glad to furnish samples and full information.

THE UNION ELECTRIC COMPANY, Dubuque, Ia., is supplying its patrons with blotters, one side of which carries an illustration furnishing an object lesson in electric lighting. On the face of the blotter photographic reproductions are given of adjacent show windows, one of which is lighted by Welsbach lights and the other by a single arc light. In the latter case all of the wares in the window are brightly illuminated, as well as the sidewalk outside; in the other case the objects in the window as well as the sidewalk are shrouded in obscurity.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that the demand for its Adams secondary generator, which it has recently placed on the market, has been unprecedented. It has received orders for this instrument from all over the United States, and a large number of inquiries from abroad. This is one of the most practical devices recently got out, and fills a long felt want. The company has some very attractive printed matter fully describing this, which will be mailed on application. The apparatus was lately illustrated and described in these pages.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has announced the opening of several "Exide" battery depots for the purpose of caring for, charging and furnishing vehicle batteries of its manufacture. The stations already announced are situated in New York, at 148 West 18th St.; Philadelphia, at 250 No. Broad St.; Buffalo, at 200 Pearl St.; St. Louis, at 3937 Olive St.; Chicago, at 264 Michigan Boulevard. It is the purpose of the Electric Storage Battery Company to open immediately stations in a number of other cities. These stations will be equipped with a stock of battery material, and will be under the charge of thoroughly experienced battery men so that orders can be filled either for complete batteries or for parts, as needed. The facilities for recharging and caring for the batteries will prove of great convenience to the increasing number of users of the "Exide" battery.

INCANDESCENT LAMPS.—An extremely handsome pamphlet of 80 pages has been issued by the Westinghouse Electric & Manufacturing Company with the title, "Incandescent Electric Light—Sawyer-Man Lamps." The numerous illustrations have been beautifully executed, and the production as a whole is one that has rarely been equalled in trade literature. The first part of the text is a historical sketch of the development of electric lighting from the time of Sir Humphry Davy to date, and the second portion gives a clear and concise account of all the steps in the manufacture of Sawyer-Man incandescent lamps. The final portion of the pamphlet is devoted to the economics of incandescent electric lighting, including the selection of lamps, renewals, regulation and distribution. One of the features of the pamphlet consists of illustrations of artistic chandeliers and of interiors showing how artistic effects may be produced with incandescent lights.

SPRAGUE COMPANY'S OUTING.—The weather on Saturday, May 17, was especially designed and constructed at the works of the Sprague Electric Company in order that the office and sales department could have a perfect day for their outing. A large number of men representing the various departments in both the New York and Watsessing offices spent the day at New Dorp, Staten Island. During the afternoon an exciting ball game was played. Henry G. Issertel, of the sales department, acted as umpire, and will be able to be out in a few days. Edgar H. Watlington, who is an authority on electric hoists, kept the score card. The most interesting feature of the game was the playing of Findlay S. Douglas, the ex-champion golf player. It was his first ball game, and when he began batting the spectators ran to cover. His first drive sent the ball into the bunker, and once, when the umpire called "high ball," Findlay exclaimed: "Make it two and I'll join you." The outing was voted a great success, and special thanks were tendered to Messrs. Bourgeois and Vanderhoof, who had managed the affair in a very acceptable manner.

FISHER CABLE TESTING SETS.—For testing insulation, capacity and conductor resistance of cables, as well as for locating faults or breaks, no apparatus is more popular to-day than the special sets designed by Mr. Henry W. Fisher, of Pittsburgh, and made by Morris E. Leeds & Co. of Philadelphia. This is evidenced by the fact that among the more prominent customers for the sets may be mentioned the following: U. S. Signal Corps, Washington, (8 sets), Standard Underground Cable Co., Pittsburgh, (3 sets), Safety Insulated Wire & Cable Co., New York, (3 sets), Reserve Construction Co., Cleveland, (2 sets), India Rubber & Gutta Percha Insulating Co., Yonkers, N. Y., W. R. Brixey, New York City, U. S. Engineer Office, Newport, R. I., Maryland Telephone & Telegraph Co., Baltimore, Columbus Citizens Telephone Co., Columbus, O., Zenith City Telephone Co., Duluth, Minn., Conklin Construction Co., Aurora, Ill., Central Construction Co., Toledo, O., Keystone Telephone Co., Philadelphia, Bell Telephone Co., Philadelphia, Interstate Telephone Co., Trenton, N. J., Nova Scotia Telephone Co., Halifax, Pittsburgh & Allegheny Telephone Co., Allegheny, Pa., Japanese Imperial Telephone Exchange, Tokio. The sale of these sets is controlled by Mr. James G. Biddle, 1023 Stephen Girard Building, Philadelphia, who acts as sole agent for Morris E. Leeds & Co. Catalogues and full particulars will be furnished upon request.

Record of Electrical Patents

11,991. ELECTRIC RAILWAY SYSTEM; G. L. Campbell, Nyack, N. Y. App. filed Aug. 21, 1900. An apparatus by which the armature resistance of a rheostat is cut out before the field resistance is cut in.

700,182. BRUSH HOLDING RING FOR DYNAMOS OR MOTORS; F. B. Duncan, Akron, O. App. filed Feb. 21, 1902. The brush holding ring is set into another ring and so constructed that it can be rotated to adjust the brushes only by passing a screwdriver or pointed instrument through a hole in the second ring and thereby push the brush ring around. This prevents accidental displacement and avoids a projecting handle.

700,207. COMBINED RHEOSTAT AND HEATER; M. C. Kruger, Chicago, Ill. App. filed Oct. 4, 1901. The resistance material is in the form of a rod having openings at intervals into which the contacts are inserted.

700,210. STORAGE BATTERY; L. W. Lombard, Boston, Mass. App. filed Feb. 11, 1902. An element composed of sheets of an oxidizable metal alternated with sheets of an unoxidizable metal, assembled closely together and being all electrically joined.

700,240. BLOCK SIGNAL SYSTEM; L. Riebe, Lansford, Pa. App. filed July 24, 1901. The semaphore arm is carried by a wheel which is adapted to be clutched to either of two other wheels moved by solenoids in opposite directions.

700,250. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed July 31, 1901. A switch is used to connect either the transmitting or receiving apparatus with the aerial terminal, making it necessary to use the switch when about to receive or send.

700,302. RAILWAY BLOCK SIGNALING SYSTEM; W. M. Chapman, Newton, and W. Pastell, Lynn, Mass. App. filed May 8, 1902. A signal is provided at each end of a block, and an actuating mechanism for each signal, both mechanisms being rendered operative to set a signal when a car enters a block from either direction.

700,310. ALTERNATING CURRENT ELECTRIC MOTOR AND CONTROLLING MEANS THEREFOR; Rudolf Eickemeyer, Dec'd., Yonkers, N. Y. App. filed Aug. 10, 1892. (See Current Nwes and Notes.)

700,335. MEANS FOR VENTILATING CORES FOR ELECTRICAL APPARATUS; J. D. Keiley, New York, N. Y. App. filed May 27, 1901. For ventilating armatures, spiral passages are formed therein.

700,340. ELECTRICAL OUTLET BOX; H. Krantz, Brooklyn, N. Y. App. filed March 26, 1902. The box has a split connecting neck, one part being integral with the box and the other separate, the separate part occupying the space of a removed portion of the box, and the two parts being clamped together.

700,346. ELECTRIC RAIL BOND; W. J. Long and J. B. Nolder, Windber, Pa. App. filed Feb. 25, 1902. The bond, consisting of a copper plate, is placed in a groove on the inner face of the fish plate.

700,380. TELEPHONE OR TELEGRAPH SYSTEM; E. Shelby, West Lafayette, Ind. App. filed Sept. 17, 1900. (See page 962.)

700,410. PLURAL FUSE CUT OUT; C. J. Dorsey, Baltimore, Md. App. filed Oct. 12, 1900. Details.

700,437. APPARATUS FOR ELECTRICALLY OPERATING TOOLS; C. E. Moore, Chicago, Ill. App. filed April 11, 1900. A reciprocating drill in which the solenoids have magnetic shields for concentrating the lines of force on the core.

700,454. SECONDARY ELECTRIC CLOCK; S. P. Thrasher, New Haven, Conn. App. filed Feb. 23, 1901. A number of drums on the same axis and bearing numbers or advertising matter on their faces, are rotated by electro-magnets step by step to bring different portions of their surfaces in line.

700,461. ELECTRIC RAILROAD SIGNAL; W. D. Vandecar, Grand Rapids, Mich. App. filed June 6, 1901. Details.

700,463. INSULATOR FOR ELECTRIC CIRCUITS; W. J. Walther, Boston, Mass. App. filed Jan. 20, 1902. A mushroom shaped insulator having strengthening ribs between the head and the post.

700,491. SAFETY SPEED LIMITING MEANS; G. W. Hendricks, Indianapolis, Ind. App. filed Oct. 14, 1901. Consists in the application to the shaft of a generator, of a loose pulley and controlling mechanism including friction-faced elements, whereby the pulley can be normally locked to and also released from the shaft.

700,494. ELECTRIC HEATER; W. B. Hinman, Joplin, Mo. App. filed Feb. 11, 1901. An electric lamp is nested in a box containing fibrous material and whose walls are perforated to allow a circulation of air. The box with the lamp in it can be thrust into a bed to warm it.

700,495. ELECTRODE FOR ARC LAMPS; R. Hopfelt, Berlin, Germany. App. filed Feb. 24, 1902. (See Current News an Notes.)

700,497. ELECTRIC BATTERY; C. Hubert, New York, N. Y. App. filed Aug. 9, 1900. The top of the cell is fitted with an annular and a central contact, flush with each other, so that when the cell is placed in a box, and the cover of the box, which is provided with contacts, is applied, the circuit can be readily connected with the contacts on the cover of the box.

700,536. APPARATUS FOR DEMONSTRATING THE PHENOMENA OF ELECTRICAL STORMS; G. J. Moore and D. C. Moore, Graham, Mo. App. filed Nov. 20, 1901. A friction generator and Leyden jars mounted in a case with suitable terminals for the purpose indicated in the title.

700,544. PIVOT CONNECTION OF CURRENT COLLECTING OR TROLLEY; P. McCullough, T. Blaney and R. Baron, Liverpool, Eng. App. filed Jan. 14, 1902. Details.

700,563. PROCESS OF EXTRACTING METALS FROM ORES AND SCRAP CONTAINING SAME; S. S. Sadtler, Philadelphia, Pa. App. filed July 10, 1900, renewed April 11, 1902. (See page 962.)

700,570. INSULATOR SUPPORTING ARM; J. E. Sharpe, Oneida, N. Y. App. filed Dec. 26, 1901. A cross-arm for insulators, made of channel metal.

700,585. ELECTRIC ALARM; D. Vial Fils, Lyons, France. App. filed July 31, 1901. A burglar alarm in which the circuit closer is a pendulum whose rod passes through a washer; when the pendulum is disturbed, the arm and washer come together.

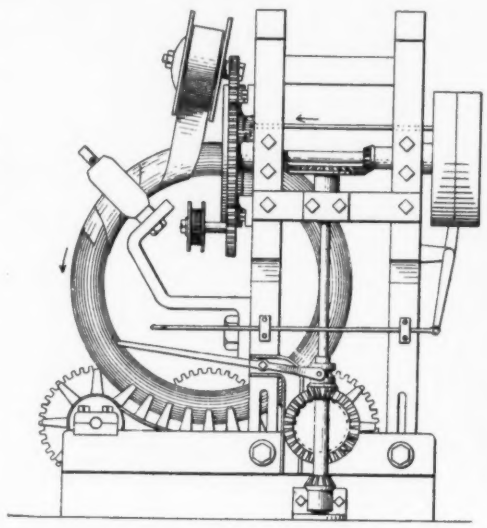
700,597. APPARATUS FOR ELECTRICALLY WINDING UP DRIVING SPRINGS; H. Aron, Charlottenburg, Germany. App. filed Feb. 20, 1902. Details.

700,598. PRIMARY BATTERY; M. M. Bair, Levallois-Perret, France. App. filed March 21, 1901. According to this invention the cell is provided with a detachable cover, so arranged that it can be secured to the outer vessel of the cell or to the outer vessel and the porous chamber of the cell by any suitable connection, such as screw-threads, clamps, catches, or other means that will firmly maintain the said cover hermetically in place and yet permit of its ready detachment.

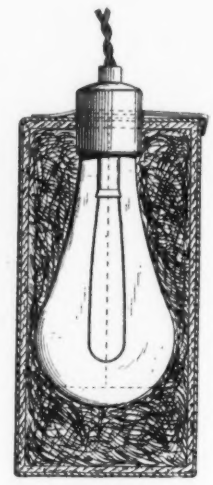
700,609. ELECTRICALLY PROPELLED VEHICLE FOR SINGLE RAIL ELEVATED RAILWAYS; F. B. Behr, Twickenham, Eng. App. filed Feb. 24, 1902. Relates to the mechanical construction of the car, enabling it to traverse curves of small radius.

700,649. ELECTRODE FOR ARC LAMPS; R. Hopfelt, Berlin, Germany. App. filed Feb. 24, 1902. (See Current News and Notes.)

700,650. ELECTRIC LAMP; C. Hubert, New York, N. Y. App. filed Aug. 9, 1900. A battery casing having a search lamp fitted to one side of it.



700,713.—Machine for Covering Coils of Wire.



700,494.—Electric Heater.

700,652. BURGLAR ALARM; G. Janke, Algoma, Wis. App. filed Dec. 31, 1901. Deetails.

700,666. STORAGE BATTERY; L. W. Lombard, Boston, Mass. App. filed March 1, 1901. The plate is built up of a series of strips strung upon a number of rods.

700,670. ELECTROLYTIC REDUCTION OF NITRO OR OTHER COMPOUNDS; M. Buchner, Manneheim, Germany. App. filed Nov. 18, 1899. (See page 962.)

700,671. REDUCTION OF AZO COMPOUNDS; M. Buchner, Mannheim, Germany. App filed Sept. 24, 1900. (See page 962.)

700,672. REDUCTION OF NITRO COMPOUNDS; M. Buchner, Mannheim, Germany. App filed Sept. 24, 1900. (See page 962.)

700,689. THIRD RAIL CONSTRUCTION FOR ELECTRIC RAILWAYS; C. M. Hobbs, Baltimore, Md. App. filed June 21, 1901. Relates to the means for maintaining electrical contact between the contact shoe and the conductor, when the latter, for any cause, is offset from its normal position.

700,695. MULTIPLE FUSE BOX; J. D. Lytle, Baltimore, Md. App. filed Aug. 23, 1901. Details.

700,708. COHERER; H. Shoemaker, Philadelphia, Pa. App. filed Oct. 16, 1901. (See Current News and Notes.)

700,713. MACHINE FOR COVERING COILS OF WIRE; G. F. Wright and G. M. Wright, Worcester, Mass. App. filed Jan. 8, 1901. A machine for winding tape around closed coils of wire.

700,715. OPERATING MECHANISM FOR MOTOR RHEOSTATS; J. I. Ayer, Malden, Mass. App. filed Feb. 17, 1902. A trolley in a conduit is moved along by the attraction of a magnet on the car and successively closes the circuit to the sections of the sectional conductor.